PALEONTOLOGICAL RESOURCES IDENTIFICATION AND EVALUATION REPORT

FOR

SR-73 BASIN SEDIMENTATION PROJECT BETWEEN JAMBOREE ROAD AND I-5/SR-73 INTERCHANGE

CITIES OF LAGUNA NIGUEL, ALISO VIEJO, LAGUNA BEACH, IRVINE, AND NEWPORT BEACH

COUNTY OF ORANGE, CALIFORNIA

CALIFORNIA DEPARTMENT OF TRANSPORTATION DISTRICT 12

EA OH 4400

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January 2009

SUMMARY OF FINDINGS

The California Department of Transportation (Department), in cooperation with the Cities of Irvine, Laguna Beach, Aliso Viejo, and Laguna Niguel, proposes to reduce sedimentation runoff into 39 storm water basins along State Route 73 (SR-73) between Jamboree Road and the Interstate 5 (I-5)/SR-73 interchange with Best Management Practices (BMPs) by reducing erosion of internal basin slopes, erosion of adjacent slopes, bare areas within the median, or any areas identified within the Department right-of-way as source contributors that drain into basins. The project proposes to treat bare soil and eroded areas with Low-Impact Developments (LIDs) such as drought-tolerant plants, native plants, and erosion control measures. Temporary irrigation will be provided for new plantings in areas where there is no available water source or existing irrigation. Basin perimeter slopes with existing irrigation that require additional planting will be repaired or upgraded for efficiency to minimize water usage during plant establishment. Some areas will require engineer design recommendations for slope repair, grading, proposed concrete v-ditches, drainage issues, improved access, and maintenance safety concerns.

The area surveyed for this project is the Area of Project Disturbance (APD) for each individual basin where excavation is proposed. Some grading is also proposed within the median areas of SR-73; however, these areas have been disturbed to the depths of proposed excavation activities primarily during the construction of SR-73 but also during subsequent maintenance work. The APD is based on the horizontal and vertical extent of anticipated ground-disturbing activities.

The study area contains 11 types of sediments. Three of these, because of their young age (less than 10,000 years), do not have the potential to contain paleontological resources and include: artificial fill, recent alluvium, and landslide deposits. Two sediments from the Quaternary Period (1.8 million to 10,000 years ago) have the potential to contain paleontological remains and include: nonmarine terrace deposits and marine terrace deposits. Six sediments from the Tertiary Period (65 to 1.8 million years ago) have the potential to contain paleontological remains and include: the Capistrano Formation, the Monterey Formation, the Undifferentiated Topanga Formation, the Bommer member of the Topanga Formation, the Los Trancos member of the Topanga Formation, and the Sespe Formation.

Of the 39 basins, 25 involve proposed ground-disturbing activities. Eight of the 25 will involve ground-disturbing activities in sediments that have a high to very high paleontological sensitivity. These include: 506R; 535L; 583I; 780R; 878R; 1032R; 1032L; and 1156R. The remaining 31 basins, either do not have ground-disturbing activities associated with them, or are located within sediments that have a low paleontological sensitivity. If plans change and ground-disturbing activities are required in any of these 31 basins, they will need to be evaluated by a qualified paleontologist based on information contained in this document and a field visit.

Recommendations from the California Environmental Quality Act (CEQA), and guidelines from the Department and Orange County, are consistent with recommendations of the Society of Vertebrate Paleontology (SVP) and indicate that impacts to nonrenewable paleontological resources must be considered during project design and construction within sensitive sediments. The literature review and records searches through museums and data maintained at LSA Associates, Inc. (LSA) produced information showing that sediments dating from the Miocene to the Pleistocene Period within the project area have the potential to contain significant nonrenewable paleontological resources. Thus, it is likely that paleontological localities will be encountered during the project excavation phase within these sediments.

This study reviews definitions of paleontological significance and definitions for rock units to have high potential and high sensitivity for the presence of nonrenewable paleontological resources.

To reduce impacts to nonrenewable paleontological resources, recommendations are made for the development of a Paleontological Mitigation Plan (PMP) for those portions of the project that are identified as having a high paleontological sensitivity, which would follow the guidelines of the Department and the Orange County Planning Department, and recommendations from the SVP prior to completion of final project design. These recommendations include:

- A preconstruction field survey in areas identified as having high paleontological sensitivity after vegetation and paving have been removed, followed by salvage of any observed surface paleontological resources prior to the beginning of additional grading.
- Attendance at the pregrade meeting by a qualified paleontologist or representative. At this meeting, the paleontologist will explain the likelihood for encountering paleontological resources, what resources may be discovered, and the methods of recovery that will be employed.
- During construction excavation, a qualified vertebrate paleontological monitor shall initially be present on a full-time basis whenever excavation will occur within the sediments that have a high paleontological sensitivity rating and on a spot-check basis in sediments that have a low sensitivity rating. Monitoring may be reduced to a part-time basis if no resources are being discovered in sediments with a high sensitivity rating (monitoring reductions and when they occur will be determined by the qualified Principal Paleontologist). The monitor shall inspect fresh cuts and/or spoils piles to recover paleontological resources. The monitor shall be empowered to temporarily divert construction equipment away from the immediate area of the discovery. The monitor shall be equipped to rapidly stabilize and remove fossils to avoid prolonged delays to construction schedules. If large mammal fossils or large concentrations of fossils are encountered, the Department will consider using heavy equipment on site to assist in the removal and collection of large materials.
- Localized concentrations of small (or micro-) vertebrates may be found in all native sediments. Therefore, it is recommended that these sediments occasionally be spot-screened on site through one-eighth to one-twentieth-inch mesh screens to determine whether microfossils are present. If microfossils are encountered, sediment samples (up to 3 cubic yards, or 6,000 pounds) shall be collected and processed through one-twentieth-inch mesh screens to recover additional fossils.
- Recovered specimens shall be prepared to the point of identification and permanent preservation. This includes the sorting of any washed mass samples to recover small invertebrate and vertebrate fossils, the removal of surplus sediment from around larger specimens to reduce the volume of storage for the repository and storage cost, and the addition of approved chemical hardeners/stabilizers to fragile specimens.
- Specimens shall be identified to the lowest taxonomic level possible and curated into an institutional repository with retrievable storage. The repository institutions usually charge a one-

time fee based on volume, so removing surplus sediment is important. The repository institution may be a local museum or university with a curator who can retrieve the specimens on request. The Department requires that a draft curation agreement be in place with an approved curation facility prior to the initiation of any paleontological monitoring or mitigation activities.

- Recommend the preparation and submittal of the Paleontological Mitigation Report (PMR) signifying completion of the PMP to the Lead Agencies.

Conformance with these generic guidelines will help reduce impacts to nonrenewable paleontological resources to a level that is less than significant. However, more project-specific measures will need to be developed during preparations of the PMP that will further reduce impacts. Final project design and construction logistics may suggest that additional project-specific measures for impact mitigation be added.

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INTRODUCTION

The California Department of Transportation (Department), in cooperation with the Cities of Irvine, Laguna Beach, Aliso Viejo, and Laguna Niguel, proposes to reduce sedimentation runoff into 39 storm water basins located along State Route 73 (SR-73) between Jamboree Road and the Interstate 5 (I-5)/SR-73 interchange with Best Management Practices (BMPs) by reducing erosion of internal basin slopes, erosion of adjacent slopes, bare areas within the median, or any areas identified within the Department right-of-way as source contributors that drain into basins. The project proposes to treat bare soil and eroded areas with Low-Impact Developments (LIDs) such as drought-tolerant plants, native plants, and erosion control measures. Temporary irrigation will be provided for new plantings in areas where there is no available water source or existing irrigation. Basin perimeter slopes with existing irrigation that require additional planting will be repaired or upgraded for efficiency to minimize water usage during plant establishment. Some areas will require engineer design recommendations for slope repair, grading, proposed concrete v-ditches, drainage issues, improved access, and maintenance safety concerns.

PROJECT LOCATION

The study area is located along approximately 15 linear miles along the SR-73 corridor, reaching from approximately the I-5 interchange in Laguna Niguel (southern limit) to Jamboree Road in Newport Beach (northern limit), and extending through the cities of Cities of Laguna Niguel, Aliso Viejo, Laguna Beach, Irvine, and Newport Beach, California (Figure 1). Specifically, the basins are located within Township 6 South, Range 9 West Irvine Ranch Sections 57, 58, 98, 134, 160, and 161; Township 7 South, Range 9 West, Irvine Ranch Section 168; and Township 7 South, Range 8 West, Section 24, Irvine Ranch Section 180 and unsectioned portions, San Bernardino Baseline and Meridian, and are depicted on the *San Juan Capistrano, Laguna Beach,* and *Tustin, California* 7.5-minute series United States Geological Survey (USGS) topographic maps (Figure 2).

The SR-73 alignment encompasses a large area and passes through urban settings consisting of residential, industrialized warehouse, and commercial business uses, as well as undeveloped areas.

PROJECT DESCRIPTION

Work for this project involves construction improvements both within individual basins and within the median areas. A brief description of each basin as well the proposed work effort follows below.

Individual Basin Descriptions

Basin 457L. Basin 457L is a small, rectangular-shaped storm water collection basin located west of SR-73 between the I-5/SR-73 interchange and Paseo de Colinas (Sheet 1, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure and sheet flows across the basin.

FIGURE 1

Legend

Project Alignment

N

0 13,500 27,000 FEET

SR-73 Basin Sedimentation Project

Project Vicinity Map

EA# 0H4400
12-ORA-73 PM 10/24.5

SOURCE: USGS 7.5' QUAD - LAGUNA BEACH ('81); SAN JUAN CAPISTRANO ('81); TUSTIN ('81); CALIF.
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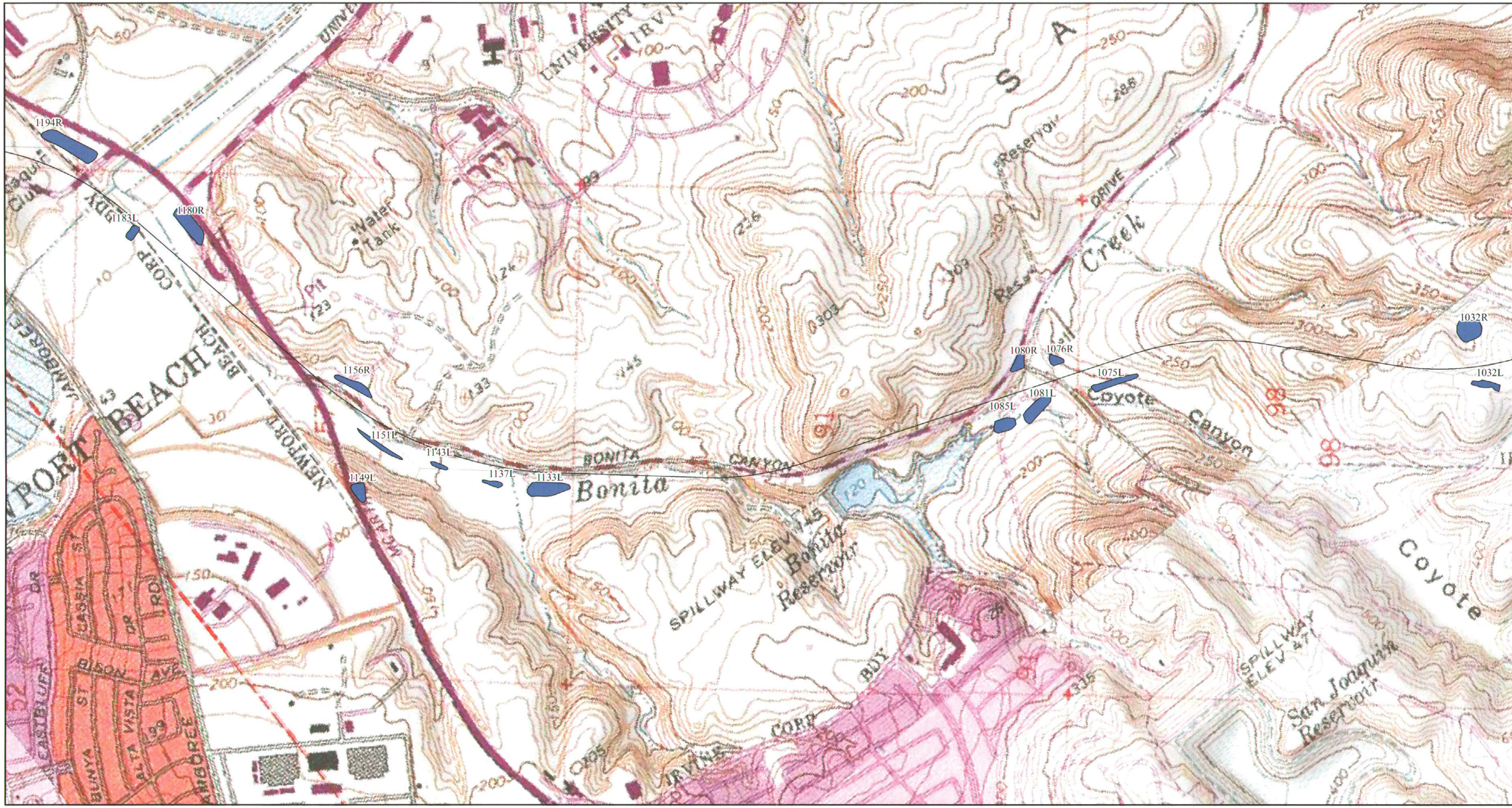

Legend
Stormwater Basin
Centerline SR-73

0 500 1,000 Feet

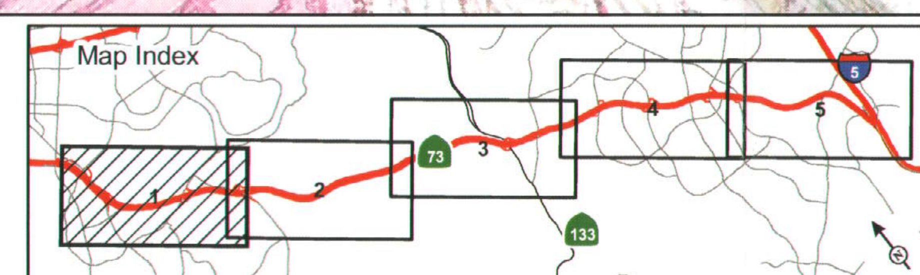

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FIGURE 2
Sheet 1 of 5

SR-73 Basin Sedimentation Project

Project Location Map

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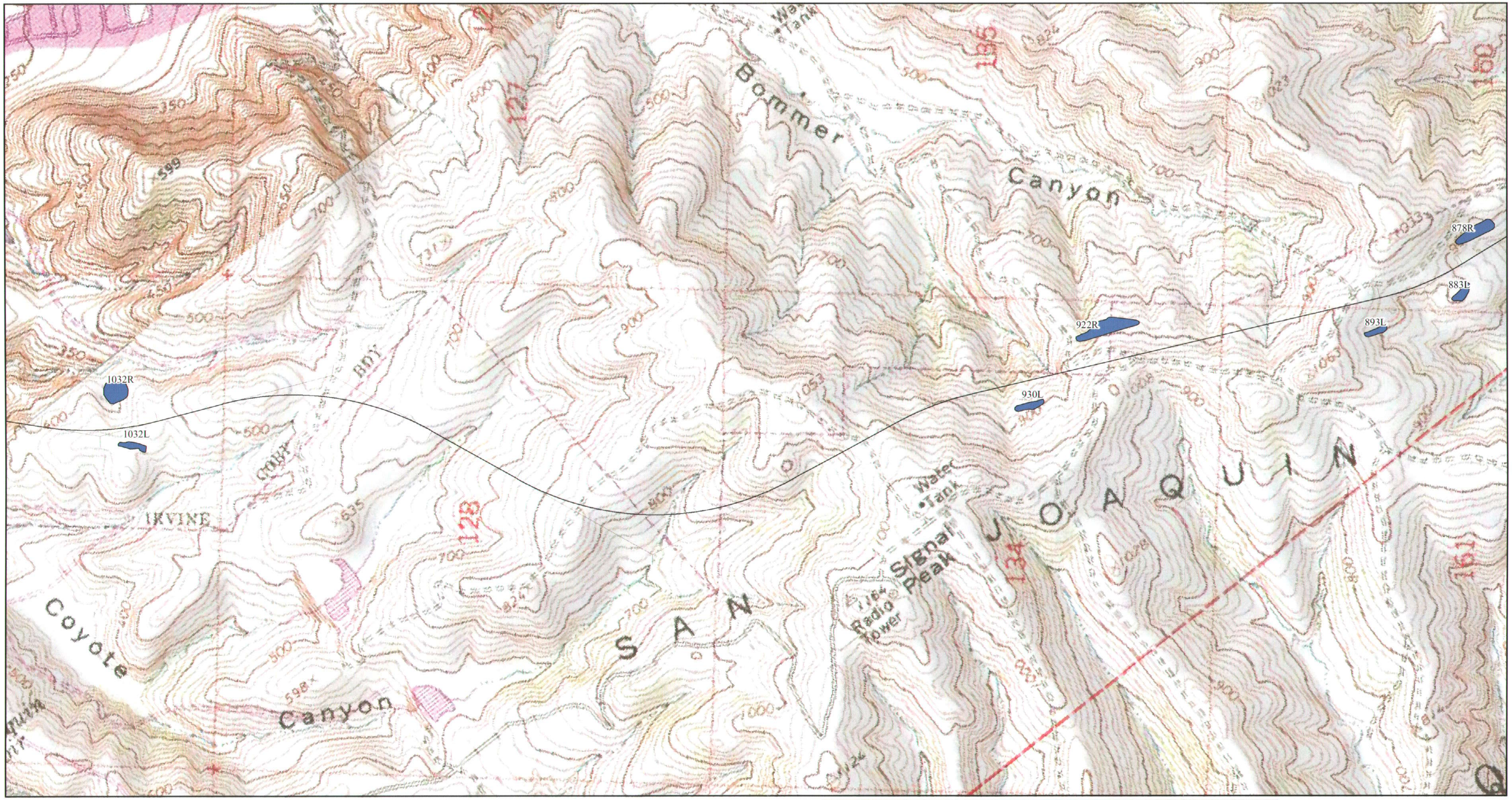

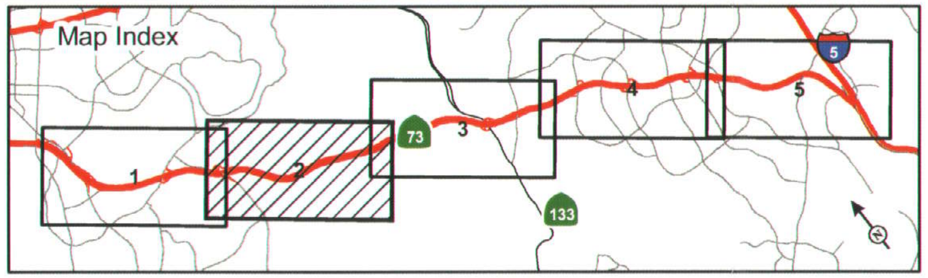

Legend
Stormwater Basin
Centerline SR-73

0 500 1,000 Feet

SOURCE: USGS 7.5'QUAD - LAGUNA BEACH ('81); SAN JUAN CAPISTRANO ('81); TUSTIN ('81); CALIF.

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FIGURE 2

Sheet 2 of 5

SR-73 Basin Sedimentation Project

Project Location Map

EA# 0H4400

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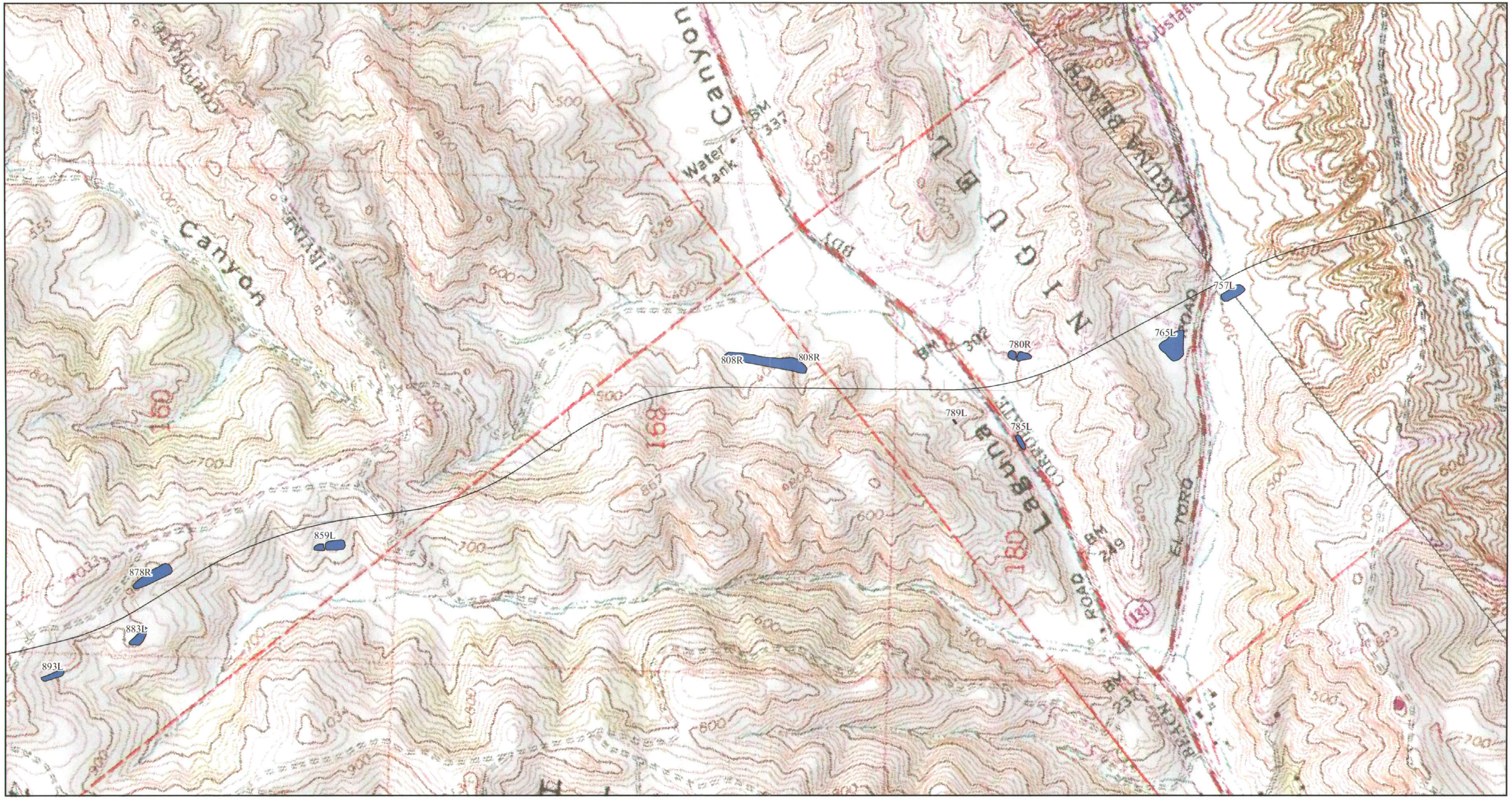
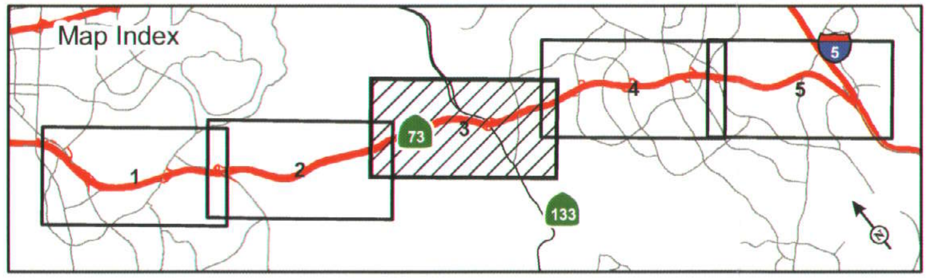


Legend
Stormwater Basin
Centerline SR-73

0 500 1,000 Feet



SOURCE: USGS 7.5'QUAD - LAGUNA BEACH ('81); SAN JUAN CAPISTRANO ('81); TUSTIN ('81); CALIF.

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FIGURE 2

Sheet 3 of 5

SR-73 Basin Sedimentation Project

Project Location Map

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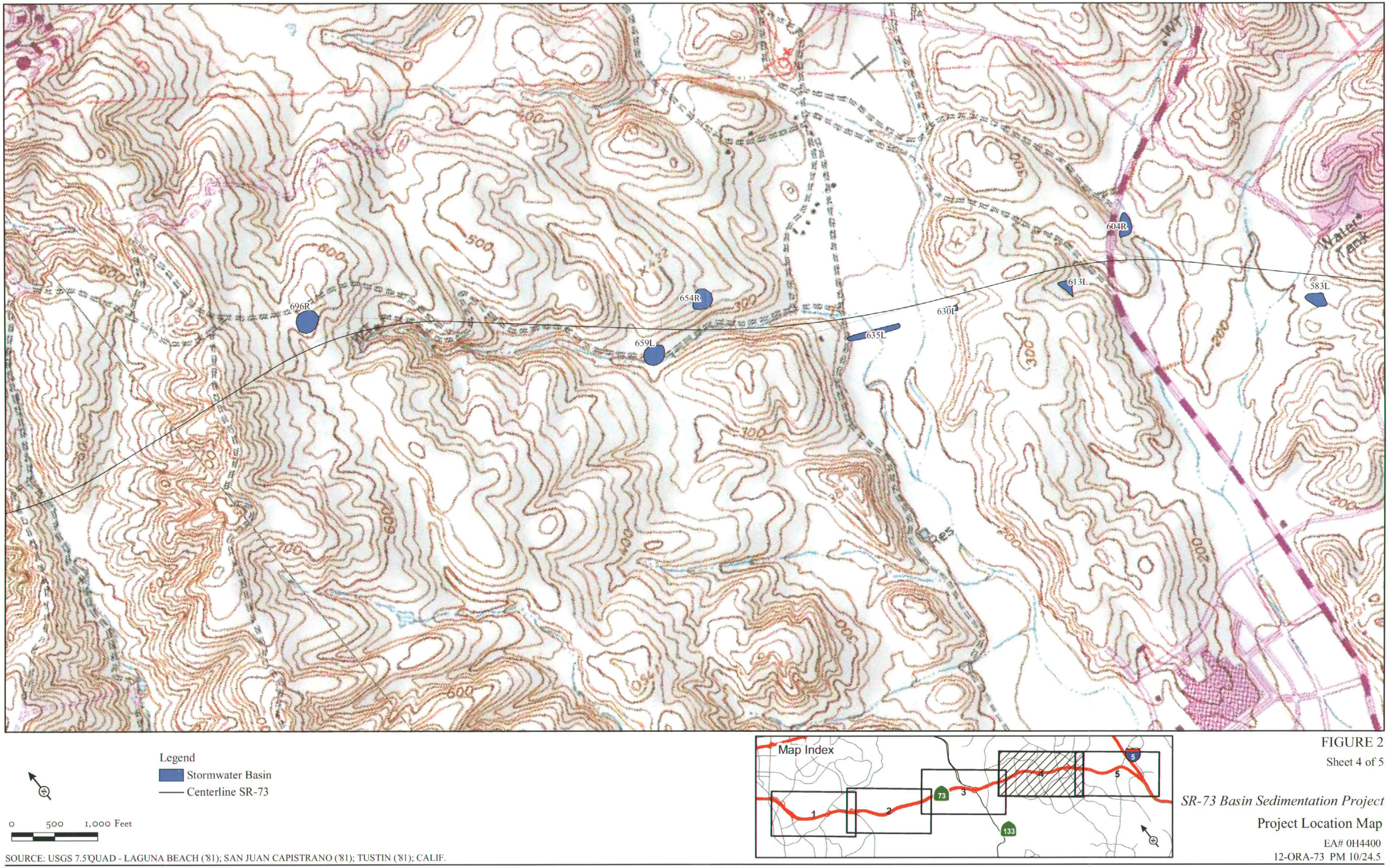

Legend
Stormwater Basin
Centerline SR-73

0 500 1,000 Feet

SOURCE: USGS 7.5'QUAD - LAGUNA BEACH ('81); SAN JUAN CAPISTRANO ('81); TUSTIN ('81); CALIF.
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FIGURE 2
Sheet 4 of 5

SR-73 Basin Sedimentation Project

Project Location Map

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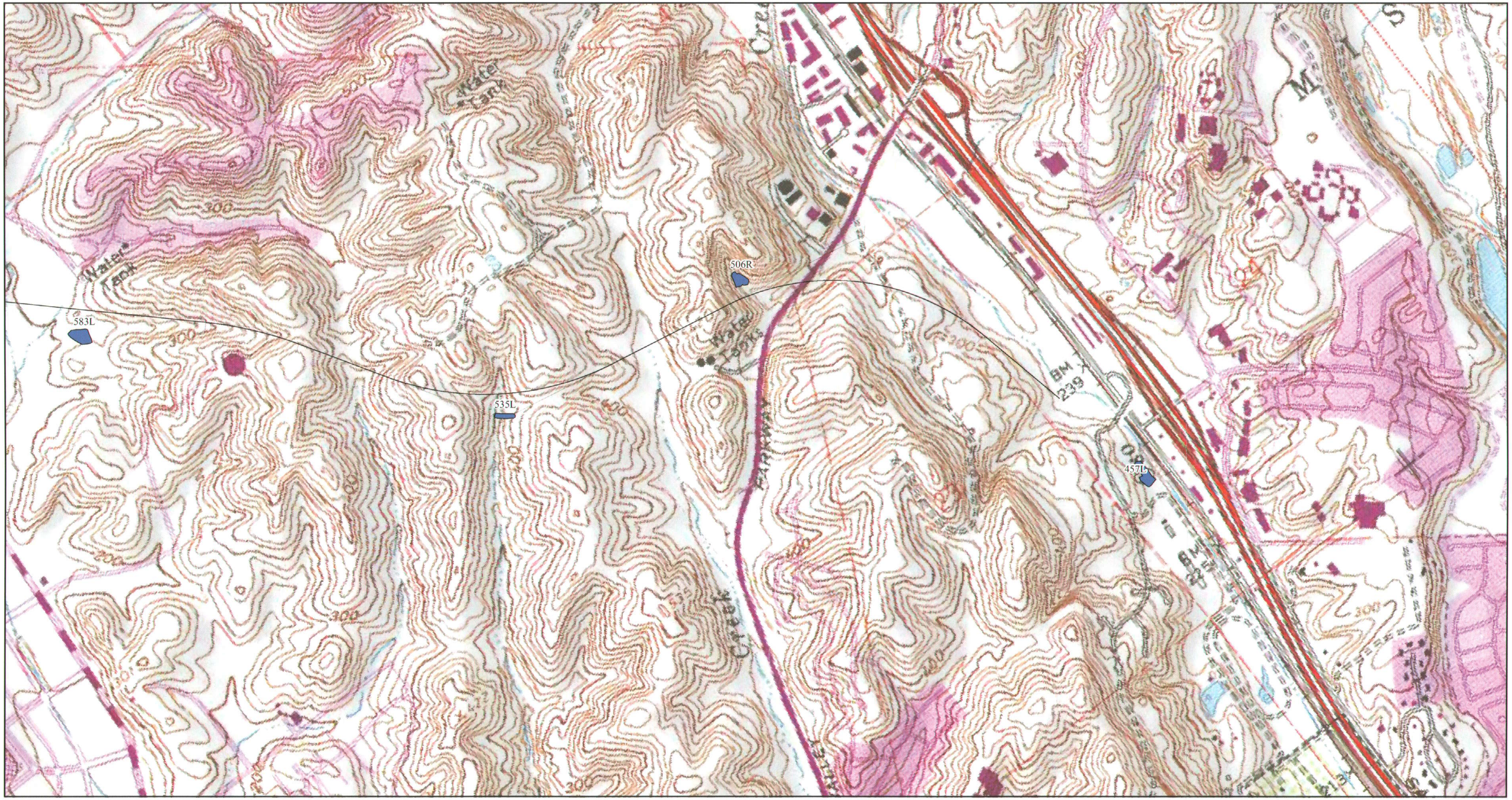

Legend
Stormwater Basin
Centerline SR-73

0 500 1,000 Feet

SOURCE: USGS 7.5'QUAD - LAGUNA BEACH ('81); SAN JUAN CAPISTRANO ('81); TUSTIN ('81); CALIF.
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FIGURE 2
Sheet 5 of 5

SR-73 Basin Sedimentation Project
Project Location Map
EA# 0H4400
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Proposed Work. The vegetation around the perimeter and adjacent slopes will be improved with drought-tolerant plants, native plants, and erosion control blankets to reduce areas with exposed soil. A new gravel access road with a concrete apron will be added to keep vehicles from tracking gravel onto the roadway. A new fence with an access gate will be added to prevent trespassing or illegal dumping. A concrete v-ditch with riprap dissipatation will be constructed to divert water runoff to the basin and prevent sedimentation from running off onto a private access road or concrete channel. Temporary erosion control such as fiber rolls will be added where feasible.

Basin 506R. Basin 506R is a rectangular-shaped storm water collection basin located north of SR-73 and west of Crown Valley Parkway (Sheet 2, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure and sheet flows across the basin.

Proposed Work. Addition of erosion control blankets on the basin slopes and a grass mix at the bottom will be proposed. A concrete v-ditch will be constructed at the toe of the perimeter slope. Gravel will be added at the roundabout area of the existing access road. Fiber rolls will be lined along the proposed and existing concrete v-ditches. The median at this location is a downhill area. Erosion control will be added to bare areas of the median. Turf block, riprap, and fiber roll will be installed around Drain Inlet N4 to help slow down water and prevent further erosion and scouring. Planting will be added to source control bare slopes.

The median area fiber rolls will be added around Inlets N5 and N6. Vegetation will be improved at the Greenfield Avenue northbound on-ramp with drought-tolerant plants, native plants and erosion control blankets to reduce areas with exposed soil. Gravel will be added for thee median turnaround access road.

Basin 535L. Basin 535L is a rectangular-shaped storm water collection basin located south of SR-73 and approximately 1,800 feet (ft) west of Green Field Drive (Sheet 3, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure and sheet flows across the basin

Proposed Work. Addition of a grass mix at the bottom of the basin is proposed. A concrete base will be constructed around the drain outlet. Vegetation will be improved with drought-tolerant plants, native plants and erosion control blankets at the perimeter slopes or adjacent slopes that feed basin 535L. Add fiber rolls along the v-ditch to prevent sedimentation from collecting into v-ditches. The median area has vegetation coverage. Add fiber roll around inlet (N7). Improve vegetation at Greenfield Ave. northbound on-ramp slopes with drought-tolerant plants, native plants, and erosion control blankets to reduce areas with exposed soil.

The median area erosion control will be added to bare areas. Turf block will be installed around Inlets N9, N10, and N11 to prevent further erosion and scouring. Fiber rolls will be added around Inlets N9, N10, and N11. Minor grading will be performed to reduce puddling and nuisance water at the median. Northbound adjacent source control bare slopes will be augmented with drought-tolerant plants, native plants, and erosion control blankets with fiber rolls at the toe of the slope.

Basin 583L. Basin 583L is a triangular-shaped, concrete-lined storm water collection basin. The basin is located to the south of SR-73 and situated adjacent to the west side of Moulton Parkway (Sheet 5, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure and sheet flows across the basin.

Proposed Work. Minor slope grading will be performed to reduce puddles and nuisance water. The vegetation coverage on the basin slopes will be improved with drought-tolerant plants, native plants, and erosion control blankets to reduce sedimentation. Grass mix will be added to the bottom of the basin. Fiber rolls will be installed at the toe of the basin slopes. The access road will be extended with a gravel base. The median vegetation is in good condition. At Inlet N15, turf block and riprap will be installed around the concrete base of the inlet to slow down the water and prevent further erosions and scouring and provide turf block at Inlets N16, N17, and N18. At the north side of Moulton Parkway Bridge, a grass mix will be added in the median. Fiber rolls will be placed around drain inlets. Gravel will be added for median turnaround at the access road near Inlets N15 and N18.

Basin 604R. Basin 604R is an oval-shaped storm water collection basin. The basin is located to the north of SR-73 and east of La Paz Road (Sheet 6, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure, and sheet flows across the basin.

Proposed Work. The vegetation will be improved with drought-tolerant plants, native plants, and erosion control blankets in a section of the basin slope and on the adjacent slopes. A grass mix will be added to the bottom of the basin. Fiber rolls will be added at the toe of the slope and around drain inlets. The gravel access road will be restored. In the median, minor grading and turf block will be added to Inlet N19 and turf block will also be added to Inlet N20. Fiber rolls will be place around drain inlets.

Basin 613L. Basin 613L is a triangular-shaped basin located south of SR-73 and west of La Paz Road (Sheet 6, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure and sheet flows across the basin.

Proposed Work. Vegetation on the basin slope and adjacent slope will be improved with drought-tolerant plants, native plants, and erosion control blankets to reduce sedimentation. A grass mix will be added at the bottom of the basin. The existing access road will be extended and restored with gravel. Paving will be added to the gore area at La Paz Road. Gravel will be added for a median turn-around access road. Erosion control will be added to bare areas in the median.

Basin 630L. Basin 630L is a small, off-line bypass storm water collection basin. The basin is located south of SR-73, west of Alicia Parkway, and east of Aliso Creek (Sheet 6, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure. The bottom of this basin is composed of concrete.

Proposed Work. Vegetation on the basin slope will be improved with drought-tolerant plants, native plants, and erosion control blankets. Fiber roll will be added at the toe of the slope. In the median, seeding will be added between La Paz Road and Alicia Parkway and, near Inlet N23. Fiber rolls will be added around the drain inlet. Vegetation will be added to source control bare slopes.

There will be no excavation in this basin.

Basin 635L. Basin 635L is a narrow west-to-east-draining storm water collection basin. The basin is located south of SR-73 and east of Aliso Creek Road (Sheets 6 and 7, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure and sheet flows across the basin.

Proposed Work. Vegetation on the basin slope will be improved with drought-tolerant plants, native plants, and erosion control blankets. A grass mix will be added at the bottom of the basin. A gravel access road will be installed. Fiber rolls will be placed around the drain inlet and at the toe of the slope. Erosion control will be added to the median between the access road and Drain Inlet N23.

Adjacent slopes to Basin 635L are a sedimentation source. These slopes will be treated with drought-tolerant plants, native plants, and erosion control blankets. Fiber rolls will be added to the toe of the slope. In the median area, an asphalt curb, a concrete v-ditch, and seeding may be considered at this location; however, further field investigation is needed. Fiber rolls will be placed around the drain inlet. In the median, erosion control will be added where there are bare soils to prevent erosion in the bioswale.

Basin 654R. Basin 654R is an oval-shaped storm water collection basin. The basin is located north of SR-73 and east of Aliso Creek Road (Sheet 7, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure and sheet flows across the basin.

Proposed Work. Vegetation within a section of the basin slope and adjacent source slopes will be improved with drought-tolerant plants, native plants, and erosion control blankets. In the median, between Inlets N25 and N27, heavy-duty erosion control blankets will be added. Fiber rolls will be added to the toe of the slopes.

There will be no excavation in this basin.

Basin 659L. Basin 659L is an oval-shaped storm water collection basin. The basin is located south of SR-73 and west of Aliso Creek Road (Sheet 7, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure and sheet flows across the basin.

Proposed Work. Vegetation within the basin slope and adjacent slopes that is a source of sedimentation will be improved with drought-tolerant plants, native plants, and erosion control blankets. In the median, erosion control will be added where there are bare soils to prevent erosion in the bioswale. Riprap will be added at the northern slope of Drain Inlet N28. Fiber rolls will be added to the toe of the slopes and drain inlets within the median or where feasible.

In the median, erosion control will be added where there are bare soils to prevent erosion in the bioswale. Fiber rolls will line the concrete v-ditch and around drain inlets. Gravel will be added for a median turnaround access road.

The median area erosion control will be added to bare areas. Turf block will be installed around Inlet N30 to prevent further erosion and scouring. Fiber roll will be added around Inlets N30 and N31. On slopes along northbound SR-73, erosion control blankets will be added to prevent sedimentation into v-ditches at the toe of the slope.

There will be no excavation in this basin.

Basin 696R. Basin 696R is an oval-shaped storm water collection basin. The basin is located north of SR-73 and east of Glenwood Drive (Sheet 9, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure and sheet flows across the basin.

Proposed Work. Vegetation within the basin slope and adjacent slopes that is a source of sedimentation will be improved with drought-tolerant plants, native plants, and erosion control blankets. Gravel will be added to the access road. Fiber roll will be placed at the toe of the slope and basin drain outlets. The bioswale within the median is in good condition. Turf block and fiber rolls will be installed around the concrete base of Inlet N32 to prevent further erosion and scouring. Gravel will be added for a median turnaround access road near Inlet N32 and under Glenwood Avenue Bridge.

There will be no excavation in this basin.

Basin 757L. Basin 757L is a riprap-lined, oval-shaped storm water collection basin that receives runoff collected from SR-73 via a 36-inch inlet structure. It is located south of SR-73, east of El Toro Road, and approximately 500 ft north of an unnamed perennial creek (Sheet 11, Appendix A). A sediment-filled, riprap-lined pilot channel extends from the inlet structure near the eastern end of the basin to the outlet structure located near the west end of the basin.

Proposed Work. No excavation will be done within this basin. Proposed work will be to improve vegetation at the adjacent northbound/southbound on- and off-ramp slopes that feed into basin 757L with drought-tolerant plants and native plants. Fiber rolls will be lined along the toe of the slope.

There will be no excavation in this basin.

Basin 765L. Basin 765L is a triangular-shaped storm water collection basin located south of SR-73 and adjacent to the west side of El Toro Road (Sheet 11, Appendix A).

Proposed Work. No work will be performed within this basin. Proposed work will be to improve vegetation at adjacent slopes that are a source of sedimentation with drought-tolerant plants, native plants, and erosion control blankets. No concrete v-ditch and seeding will be needed at this location. An asphalt concrete curb will be constructed along the toe of the slope. Fiber rolls will be lined along the existing concrete v-ditch. A fence and gate will be added.

Basin 780R. Basin 780R is a triangular-shaped storm water collection basin located north of SR-73 and east of Laguna Canyon Road (Sheets 11 and 12, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure and sheet flows across the basin.

Proposed Work. Vegetation within the basin slope and adjacent slopes that is a source of sedimentation will be improved with drought-tolerant plants, native plants, and erosion control blankets. A grass mix will be added at the bottom of the basin. The slope will be repaired and a catchment wall will be added along the northbound Laguna Canyon Road exit (0.5 acre of impact in coastal sage scrub [CSS] vegetation area). The existing concrete v-ditch and toe of the slopes will be lined with fiber rolls. Paving will be added at the gore area. The bioswale within the median is in good condition. Gravel will be added for a median turnaround access road. Cattails in the in concrete v-ditch will be cleaned out. A retaining wall will be added at the toe of the excavated slope.

Basin 785L. Basin 785L is a small, rectangular-shaped storm water collection basin situated on a terraced hillside located upslope of Laguna Canyon Creek, south of SR-73, and west of Laguna Canyon Road (Sheet 12, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure and sheet flows across the basin.

Proposed Work. Vegetation within the basin slope and adjacent slopes that is a source of sedimentation will be improved with drought-tolerant plants, native plants, and erosion control blankets. A grass mix will be added at the bottom of the basin. Paving and gravel access will be constructed. Fencing and an access gate will be added. Fiber rolls will be added around the inlet and toe of the slope.

Basin 789L. Basin 789L is a small, oval-shaped storm water collection basin located south of SR-73 and west of Laguna Canyon Road (Sheet 12, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure and sheet flows across the basin.

Proposed Work. There is a safety concern with maintenance access. The Design Engineer will provide design alternatives during the Project Report phase. A grass mix will be added at the bottom of the basin. Gravel access will be replenished and outlet filters will be cleaned. Fiber rolls will be placed around the inlet.

Basin 808R. Basin 808R is a long, linear-shaped storm water collection basin located north of SR-73 and approximately 1,600 ft west of Laguna Canyon Road (Sheets 12 and 13, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure and sheet flows across the basin.

Proposed Work. The median drain inlets will be cleaned and repaired.

The median is well vegetated. Turf block will be installed around Inlet N42. Riprap will be repaired around Inlets N41 and N42. Fiber rolls will be placed around the inlet.

Within the median, no erosion control seeding is needed. Turf block and riprap will be installed around Inlets N40 and N3. A.C. paving will be repaired.

There will be no excavation in this basin.

Basin 859L. Basin 859L is an oval-shaped storm water collection basin located south of SR-73 (Sheet 14, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure and sheet flows across the basin.

Proposed Work. Grass mix will be added at the bottom of the basin. Turf block and riprap will be installed around Inlets S37 and S38. Fiber rolls will also be placed at the toe of the slope to prevent sediment deposit in the existing v-ditches. Fiber rolls will be placed around the inlet.

There will be no excavation in this basin.

Basin 878R. Basin 878R is an oval-shaped storm water collection basin located north of SR-73 and approximately 1,600 ft east of the toll plaza (Sheet 15, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure and sheet flows across the basin.

Proposed Work. Vegetation within the basin slope and adjacent slopes that is a source of sedimentation will be improved with drought-tolerant plants, native plants, and erosion control blankets. V-ditches will be added at the north side of the basin slope to carry storm water in the basin. The proposed work will impact 0.07 acre of CSS vegetation area. An asphalt apron entry and gravel access road will be added. Asphalt concrete curb will be added to prevent scour from the roadway drain. Fiber roll will be placed at the toe of the slope and basin drain inlets. Bioswale within the median is in good condition. No seeding is needed at the median. Erosion control blankets and fiber rolls will be installed around the concrete base of Inlets N36 and N35 to prevent further erosion and scouring. Fiber rolls will also be placed at the toe of the slope to prevent sediment deposit in the existing v-ditches.

Basin 883L. Basin 883L is a kidney-shaped storm water collection basin located south of SR-73 and approximately 1,500 ft east of the toll plaza (Sheet 15, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure and sheet flows across the basin.

Proposed Work. A grass mix will be added at the bottom of the basin. An asphalt apron entry will be added and gravel will be applied to the eastern portion of the access road.

The median is well vegetated. In the median, erosion control will be added where there are bare soils to prevent erosions in the bioswale. Erosion control blankets and fiber rolls will be installed around Inlet S35. Fiber rolls will be added at the toe of the slope of the median drain.

There will be no excavation in this basin.

Basin 893L. Basin 893L is a small, oval-shaped storm water collection basin located south of SR-73 and east of the toll plaza (Sheet 15, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure and sheet flows across the basin.

Proposed Work. Improve vegetation with drought-tolerant plants, native plants and erosion control blankets along the northern slope (next to roadway) and slopes adjacent to toll parking lot. And add fiber rolls at the toe-of-slope. Add grass mix to the bottom of the basin. Construct asphalt apron entry and apply gravel to access road. No seeding, v-ditches, and fiber rolls are needed in the median. Erosion control blankets and fiber rolls will be installed around inlet (S00).

Erosion control bare areas in the median between the northbound mainline and toll booths.

There will be no excavation in this basin.

Basin 922R. Basin 922R is a triangular-shaped storm water collection basin located north of SR-73 (Sheet 16, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure and sheet flows across the basin.

Proposed Work. Vegetation will be improved with drought-tolerant plants, native plants, and erosion control blankets along the v-ditches at slope near the bridge. Fiber rolls will be added at the toe of the slope. Gravel will be applied to the access road near the v-ditches area. Grass mix will be added to the bottom of the basin and erosion control blankets will be added at the inner slope of the basin. Regrading, cleaning of riprap, and addition of fiber rolls will be performed at Drain Inlets S33 and S32. Two access gates will be added.

The median is well vegetated. Riprap will be installed around Inlets S30 and S28. Approximately 20 ft of existing v-ditches will be removed and riprap dissipation will be applied at Inlet S27. Vegetation will be improved with drought-tolerant plants, native plants, and erosion control blankets at the northern source slope of the highway to cover exposed eroded soil. Gravel will be added for a median turnaround access road near Inlet S26.

The drainage swale will be repaired and improved to reduce erosion, and the slope and drainage ditches below both sides of wildlife crossing will be repaired and stabilized.

Sediment at Inlets S22 and S21 will be cleaned and removed, and riprap will be installed around the inlet. Vegetation will be improved with drought-tolerant plants, native plants, and erosion and control blankets in the area between the mainline and off-ramp. Fiber rolls will be added at the toe and top of the slope.

Basin 930L. Basin 930L is a rectangular-shaped storm water collection basin located south of SR-73 (Sheet 16, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure and sheet flows across the basin.

Proposed Work. The work proposed at this location will be to add temporary erosion control (straw fiber rolls) at the toe of the slope, grasses at the bottom of the basin, and gravel to replenish a portion of the access road with the existing paved apron, as well as to install a chain-link fence with a gate.

There will be no grading in this basin.

Basin 1032L. Basin 1032L is a rectangular-shaped storm water collection basin located south of SR-73 and west of Newport Coast Drive (Sheet 20, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure and sheet flows across the basin.

Proposed Work. Gravel will be applied for the maintenance access road. Vegetation will be improved with drought-tolerant plants, native plants, erosion control blankets, and fine grading at the receiving basin west of Basin 1032L. Fiber rolls will be added at the toe of the slope. Grass mix will be added to the bottom of the basin and erosion control blankets will be added at the inner slope of the basin.

Vegetation will be improved with drought-tolerant plants, native plants, and erosion control blankets. Fiber rolls will be added at the toe and top of the slope. Grass mix will be added to the bottom of the basin and erosion control blankets will be added at the inner and outer slope of the basin. Improvement of the basin slope with minor grading has been proposed.

V-ditches in median will continue on northbound SR-73 from the existing location to the last inlet before Newport Coast Drive. The median is well vegetated. However, erosion control seeding will be needed between Inlets S20 and S19. Erosion control blankets will be added at Inlet S19. Vegetation perimeter slopes will be improved with a temporary irrigation system.

Basin 1032R. Basin 1032R is an oval-shaped storm water collection basin located north of SR-73 and east of Newport Coast Drive (Sheet 20, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure and sheet flows across the basin.

Proposed Work. Vegetation around the perimeter and adjacent slopes will be improved with drought-tolerant plants, native plants, and erosion control blankets. Temporary irrigation for watering will be provided to establish planting. Fiber roll will be installed around the perimeter slopes, the toes of the slopes, and drain inlets. Seeding will be added at the bottom of the basin. The median area is well vegetated. Erosion control blankets will be added at the inner slope and outer slope of the basin. Drain inlet will be protected with fiber rolls. A catchments wall will be installed at the toe of the slope of the loop on-ramp.

The median area will be cleaned, erosion control blankets will be added around Drain Inlets S16 and S17, and seed will be placed around the drain inlets.

The existing vegetation is in good condition. Where there is loose soil, erosion control blankets will be applied. Fiber rolls will be installed around the drain inlets.

Basin 1075L. Basin 1075L is a rectangular-shaped storm water collection basin located south of SR-73 and east of Bonita Canyon Road (Sheet 21, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure and sheet flows across the basin from north to south.

Proposed Work. In the basin, minor slope repair will be performed and vegetation will be improved with drought-tolerant plants, native plants, and erosion control blankets. Grass mix will be added to the bottom of the basin. Fiber rolls will be installed at the toe of the slopes. The access road will be replenished with gravel.

Basin 1076R. Basin 1076R is a triangular-shaped storm water collection basin located north of SR-73 and east of Bonita Canyon Road (Sheet 21, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure and sheet flows across the basin from north to south.

Proposed Work. Vegetation will be improved in the basin and adjacent areas with drought-tolerant plants, native plants, and erosion control blankets. Grass mix will be added to the bottom of the basin. The access road will be replenished with gravel and a concrete paving apron will be constructed. Fiber rolls will be added at the toe of the slope and around drain inlets.

Basin 1080R. Basin 1080R is a concrete-lined storm water collection basin. The basin is located north of SR-73 and east of Bonita Canyon Road (Sheet 21, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure and sheet flows across the basin.

Proposed Work. Vegetation in the basin and adjacent areas will be improved with drought-tolerant plants, native plants, and erosion control blankets. The access road will be replenished with gravel. Fiber rolls will be added at the toe of the slope and around drain inlets. At Drain Inlet N68, erosion control blankets will be added around the concrete base. Turf block will be installed around Drain Inlet N67. In the median area, where there is loose soil, erosion control blankets with hydroseed will be applied.

Turf block will be installed around Drain Inlet S14's concrete base. In the median area, where there is loose soil, erosion control blankets with hydroseed will be applied.

In the median area, where there is loose soil, erosion control blankets with hydroseed and seedlings will be applied. Turf block and riprap will be installed around Drain Inlet S13. Fiber roll will be added to Drain Inlet 12. Filter fabric and riprap will be installed at Drain Inlet S11. Fiber rolls will be installed around the drain inlet.

There will be no excavation in this basin.

Basin 1081L. Basin 1081L is a triangular-shaped storm water collection basin located south of SR-73 and east of Bonita Canyon Road (Sheet 21, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure and sheet flows across the basin from north to south.

Proposed Work. Vegetation in the basin and adjacent areas will be improved with drought-tolerant plants, native plants, and erosion control blankets. Add grass mix to the bottom of the basin. The access road will be replenished with gravel and a concrete paving apron will be constructed. Fiber rolls will be added at the toe of the slope and around drain inlets.

Basin 1085L. Basin 1085L is a small offline bypass storm water collection basin. The basin is located adjacent to and south of a tributary of Bonita Creek, south of SR-73, and west of Bonita Canyon Road (Sheets 21 and 22, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure.

Proposed Work. Vegetation in the basin and adjacent areas will be improved with drought-tolerant plants, native plants, and erosion control blankets. The access road will be replenished with gravel. Fiber rolls will be added to the toe of the slope.

There will be no grading in this basin.

Basin 1133L. Basin 1133L is an oval-shaped, south-to-north-draining concrete-lined storm water collection basin. The basin is located to the west of SR-73, and south of Bison Avenue (Sheet 23, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure, and sheet flows across the basin.

Proposed Work. Improvement of the basin slope with minor grading and addition of erosion control blankets are proposed. The bottom of the basin will be hydroseeded. Vegetation on the perimeter and adjacent slopes will be improved with drought-tolerant plants, native plants, and erosion control blankets. Fiber rolls will be added at the toe of the slopes. Along the mainline adjacent from the basin, asphalt concrete curb will be added. The access road will be replenished with gravel.

Basin 1137L. Basin 1137L is a small, triangular-shaped storm water collection basin located west of SR-73 and north of Bison Avenue (Sheets 23 and 24, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure and sheet flows across the basin from north to south.

Proposed Work. Vegetation will be improved on the perimeter slope with drought-tolerant plant or native plants and erosion control blankets. Fiber rolls will be added at the toe of the slopes. The basin slope and basin bottom will be hydroseeded. The access road will be replenished with gravel. Fiber roll and turf block will be installed around Drain Inlet S9A.

There will be no grading in this basin.

Basin 1143L. Basin 1143L is a small, oval-shaped storm water collection basin located west of SR-73 and south of MacArthur Boulevard (Sheets 23 and 24, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure and sheet flows across the basin.

Proposed Work. Erosion control blankets will be installed on the basin slope and the basin bottom will be hydro-seeded. Vegetation on adjacent slopes will be improved with drought-tolerant plants, native plants, and erosion control blankets. Temporary irrigation will be provided to establish planting. The bare area of the access road will be filled in with gravel. Riprap will be added around the drain inlet.

There will be no grading in this basin.

Basin 1149L. Basin 1149L is an oval-shaped storm water collection basin located west of MacArthur Boulevard (Sheet 24, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure and sheet flows across the basin.

Proposed Work. Existing vegetation on the basin slope will be improved with drought-tolerant or native plants and erosion control blankets. Bare areas of the adjacent slopes will be restored with erosion control blankets. The existing access road will be replenished with gravel.

Existing vegetation on the adjacent slope to Basin 1156R will be improved with drought-tolerant or native plants and erosion control blankets. Fiber roll will be added around drain inlets.

There will be no grading in this basin.

Basin 1151L. Basin 1151L is a narrow, south-to-north-draining concrete-lined storm water collection basin. The basin is located to the west of SR-73 and situated partially under the MacArthur Boulevard overpass (Sheet 24, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure and sheet flows across the basin.

Proposed Work. Minor grading is proposed to prevent further standing water within the basin. The bottom of the basin will be hydroseeded and erosion control blankets will be added on disturbed areas of the basin. The access road will be cleaned up and regraveled. Vegetation on adjacent slopes will be improved with drought-tolerant or native plants and erosion control blankets. Fiber rolls will be added at the toes of the slopes.

Basin 1156R. Basin 1156R is a south-to-north-draining, concrete-lined rectangular-shaped storm water collection basin. The basin is located to the east of SR-73 and partially under the MacArthur Boulevard overpass (Sheet 24, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure. A sediment-filled, concrete-lined pilot channel extends from the inlet structure near the southern end of the basin to the outlet structure located near the north end of the basin.

Proposed Work. Minor grading is proposed to prevent further standing water within the basin. The bottom of the basin will be hydroseeded and erosion control blankets will be added on disturbed areas of the basin. The access road to the adjacent Basin 1148R will be cleaned up and regraveled. A section of the existing concrete v-ditch will be redesigned to resolve a standing water issue. Vegetation will be improved on adjacent slopes with drought-tolerant plant or native plants and erosion control blankets. Fiber roll will be added at the toes of the slopes and drain inlets.

Basin 1180R. Basin 1180R is a south-to-north-draining, concrete-lined, rectangular-shaped storm water collection basin. The basin is located east of SR-73, west of MacArthur Boulevard, and south of University Drive (Sheet 25, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure. A concrete-lined pilot channel extends approximately 200 ft, from the inlet structure near the southern end of the basin to the outlet structure located near the north end of the basin.

Proposed Work. Existing vegetation on the perimeter slopes will be improved with drought-tolerant or native plants and erosion control blankets. Fiber roll will be added at the toes of the slopes and around drain inlets. Adjacent basins/slopes are a north source of sedimentation and will be treated with drought-tolerant or native plants, erosion control blankets, and gravel for the existing dirt access road. A catchment wall will be provided along the access road where a steep cut creates erosion.

Basin 1183L. Basin 1183L is a west-to-east-oriented, concrete-lined, rectangular-shaped storm water collection basin. The basin is located partially under the southbound side of SR-73, north of University Drive and south of San Diego Creek (Sheets 25, Appendix A). Runoff from SR-73 is collected within the basin via a 36-inch inlet structure. Runoff appears to sheet-flow across the basin in an easterly direction.

Proposed Work. Erosion control blankets will be applied to the inner basin slope. Hydroseed will be applied to the bottom of the basin. The perimeter slope will be planted with drought-tolerant or native plants.

There will be no grading in this basin.

Basin 1194R. Basin 1194R is a mostly concrete-lined, rectangular-shaped storm water collection basin that receives runoff collected from SR-73 via a 36-inch inlet structure. It is located east of SR-73, west of MacArthur Boulevard, south of Jamboree Road, and north of San Diego Creek (Sheets 25 and 26, Appendix A). Runoff appears to sheet-flow across the basin from north to south.

Proposed Work. Erosion control blankets will be applied to the basin slopes and adjacent slopes. Hydroseed will be applied to the bottom of the basin. The perimeter slope will be planted with drought-tolerant or native plants. Fiber roll will be added to the toe of the slope and drain inlets. Gravel will be added to the access road. Existing vegetation in the median is in good condition.

There will be no grading in this basin.

PURPOSE OF INVESTIGATION

Significant nonrenewable paleontological resources, including vertebrate fossils and unique or scientifically important invertebrate fossils and remains of fossil plants, are recognized by the State of California and National Environmental Policy Act (NEPA) (Appendix B).

The paleontological records search and field assessment were conducted pursuant to the California Environmental Policy Act (CEQA), Public Resources Code (PRC) 21000 (Division 13), California Code of Regulations (CCR) 15000 (Title 14, Division 3, Chapter 1); CEQA Appendix G; PRC 5097.5. The assessment documents the potential for paleontological resources older than 10,000 years to occur within each basin location. According to the Department Standard Environmental Reference (SER) Volume 1, Chapter 8,[1] the usual approach to addressing project-related paleontological resources involves identification, evaluation, and, if necessary, mitigation. These three steps generally entail preparation of several documents that include (1) a Paleontological Identification Report (PIR); (2) a Paleontological Evaluation Report (PER); and, if a potential for encountering significant resources is determined, (3) a Paleontological Mitigation Plan (PMP). At the conclusion of grading, two additional documents may need to be prepared: a Paleontological Mitigation Report (PMR) and a Paleontological Stewardship Summary (PSS).

The paleontological resources assessment was also prepared in accordance with guidelines on a national level, including those from NEPA (P.L. 91–190, 83 Stat. 852, 42 United States Code [USC] 4321–4327), the Federal Land Policy and Management Act of 1976 (FLPMA, P.L. 94–579, 43 USC 1701–1782), and the Paleontological Resource Management 1998, Bureau of Land Management (BLM) Handbook H-8270-1.

On a local level, as far back as the 1970s, the County has recognized the need to try to preserve its fossil heritage. The County developed a set of guidelines (Resolution 77-866) that stated that developers on projects that involved earthwork were required to hire a professional paleontologist to:

- Conduct literature and a records research prior to the start of grading to determine whether fossils might be encountered during construction;
- Conduct surveys prior to the beginning of grading to determine the significance and extent of fossils of fossil-bearing sediments within the project;
- Provide trained paleontological monitors to collect fossil remains during grading; and
- Preserve any collected fossils by maintaining them in an undisturbed condition, or by excavating and salvaging in a scientific manner and keeping the fossils readily accessible for future study, if possible.

[1] Available on the Web at http://www.dot.ca.gov/ser/vol1/sec3/physical/Ch08Paleo/chap08paleo.htm.

SIGNIFICANCE

Definitions of Significance

The Society of Vertebrate Paleontology (SVP; 1995) provides the following definitions of significance.

- **Significant Nonrenewable Paleontological Resources** are fossils and fossiliferous deposits, here restricted to vertebrate fossils and their taphonomic and associated environmental indicators. This definition excludes invertebrate and botanic fossils except when present within a given vertebrate assemblage. Certain plant and invertebrate fossils or assemblages may be defined as significant by a project paleontologist, local paleontologist, specialist, special interest groups, Lead Agencies, or local governments.
- A **Significant Fossiliferous Deposit** is a rock unit or formation that contains significant nonrenewable paleontological resources, here defined as comprising one or more identifiable vertebrate fossils, large or small, and any associated invertebrate and plant fossils, traces, or other data that provide taphonomic, taxonomic, phylogenetic, ecologic, and stratigraphic information (ichnites and trace fossils generated by vertebrate animals [e.g., trackways or nests and middens], which provide datable material and climatic information). Paleontological resources are considered to be older than recorded history and/or older than 5,000 years before the present (YBP).

According to the Department, the significance of a paleontological resource may be stated for a particular fossil species, fossil assemblage, or a rock unit as a whole. There are two generally recognized types of paleontological significance:

- **National.** A National Natural Landmark-eligible paleontological resource is an area of national significance (as defined under 36 CFR 62) that contains an outstanding example of fossil evidence of the development of life on earth. This is the only codified definition of paleontological significance.
- **Scientific.** Definitions of a scientifically significant paleontological resource can vary by jurisdictional agency and paleontological practitioner.

Generally, scientifically significant paleontological resources are identified sites or geological deposits containing individual fossils or assemblages of fossils that are unique or unusual, are diagnostically or stratigraphically important, and add to the existing body of knowledge in specific areas stratigraphically, taxonomically, or regionally (SVP, 1995). Particularly important are fossils found *in situ* (undisturbed) in primary context (i.e., fossils that have not been subjected to disturbance subsequent to their burial and fossilization). As such, they aid in stratigraphic correlation, particularly those offering data for the interpretation of tectonic events, geomorphologic evolution, paleoclimatology, the relationships between aquatic and terrestrial species, and evolution in general. Discovery of *in situ* fossil-bearing deposits is rare for many species, especially vertebrates. Terrestrial vertebrate fossils are often assigned greater significance than other fossils because they are rarer than other types of fossils. This is primarily due to the fact that the best conditions for fossil preservation include little or no disturbance after death and quick burial in oxygen-depleted, fine-grained sediments. While these conditions often exist in marine settings, they are relatively rare in terrestrial settings. This has ramifications on the amount of scientific study needed to adequately characterize an individual species and therefore affects how relative sensitivities are assigned to formations and rock units.

During the development of a model curation program for Orange County, Eisentraut and Cooper (2002) stated that fossils are judged to be scientifically significant if they meet any of the following criteria within the following categories:

- **Taxonomy.** Assemblages that contain rare or unknown taxa, such as defining new (previously unknown to science) species, or that represent a species that is the first or has very limited occurrence within the area or formation.
- **Evolution.** Fossils that represent important stages or links in evolutionary relationships or fill gaps or enhance underrepresented intervals in the stratigraphic record.
- **Biostratigraphy.** Fossils that are important for determining or confining relative geologic (stratigraphic) ages or for use in defining regional to interregional stratigraphic associations. These fossils are often known as biostratigraphic markers and represent plants or animals that existed for only a short and restricted period in the geologic past.
- **Paleoecology.** Fossils that are important for reconstructing the ancient organism community structure and interpretation of ancient sedimentary environments. Depending on which fossils are found, much can be learned about the ancient environment, from water depth, temperature, and salinity to what the substrate was like (muddy, sandy, or rocky), and even to whether the area was in a high energy location (e.g., a beach) or a low energy location (e.g., a bay). Even terrestrial animals can contain information about the ancient environment. For example, an abundance of grazing animals such as horse, bison, and mammoth suggest more of a grassland environment, while an abundance of browsing animals such as deer, mastodon, and camel suggest more of a brushy environment. Preserved parts of plants can also lend insight into what was growing in the area at a particular time. In addition, by studying the ratios of different species to each other's population densities, relationships between predator and prey can be determined.

  There is a complex but vital interrelationship among evolution, biostratigraphy, and paleoecology. Biostratigraphy (the record of fossil succession and progression) is the expression of evolution (change in populations of organisms through time), which in turn is driven by natural selection pressures exerted by changing environments (paleoecology).
- **Taphonomy.** Fossils that are exceptionally well or unusually/uniquely preserved or that are relatively rare in the fossil record. These could include preservation of soft tissues such as hair, skin, or feathers from animals or the leaves/stems of plants that are not commonly fossilized.

Summary of Significance

This document uses an abbreviated summary defining significance in paleontological resources: all vertebrate fossils that can be related to a stratigraphic context are significant and are considered significant nonrenewable paleontological resources. Invertebrate and plant fossils, as well as other environmental indicators associated with vertebrate fossils, are considered significant. Certain invertebrate and plant fossils that are regionally rare or uncommon, or that help to define stratigraphy, age, or taxonomic relationships, are considered significant.

SENSITIVITY

Definitions of Sensitivity

The SVP (1995) provides the following definitions of sensitivity.

- **Paleontological Sensitivity** is determined only after a field survey of the rock unit in conjunction with a review of available literature and paleontological locality records. In cases where no subsurface data are available, sensitivity may be determined by subsurface excavation.
- **Paleontological Potential** is the potential for the presence of significant nonrenewable paleontological resources. All sedimentary rocks, some volcanic rocks, and some metamorphic rocks have potential for the presence of significant nonrenewable paleontological resources. Review of available literature may further refine the potential of each rock unit, formation, or facies. The SVP and the Riverside County Planning Department have only three categories of sensitivity: high, low, and undetermined. If a geographic area or geological unit is classed as having undetermined potential for paleontological resources, studies must be undertaken to determine if that rock unit has a sensitivity of either high or low. The field survey may extend outside the defined project to areas where rock units are better exposed. Each of the potentials is defined below in more detail.
    - **High Potential.** Rock units from which vertebrate or significant invertebrate fossils or significant suites of plant fossils have been recovered are considered to have a have potential for containing significant nonrenewable fossiliferous resources. These units include, but are not limited to, sedimentary formations and some volcanic formations that contain significant nonrenewable paleontological resources anywhere within their geographical extent, and sedimentary rock units temporally or lithologically suitable for the preservation of fossils. Sensitivity comprises both (1) the potential for yielding abundant or significant vertebrate fossils or for yielding a few significant fossils, large or small, and vertebrate, invertebrate, or botanical; and (2) the importance of recovered evidence for new and significant taxonomic, phylogenetic, ecologic, or stratigraphic data. Areas that contain potentially datable organic remains older than Recent, including deposits associated with nests or middens, and areas that may contain new vertebrate deposits, traces, or trackways are also classified as significant.
    - **Low Potential.** Reports in the paleontological literature or field surveys by a qualified vertebrate paleontologist may allow determination that some areas or units have low potentials for yielding significant fossils. Such units will be poorly represented by specimens in institutional collections. These deposits generally will not require protection or salvage operations.
    - **Undetermined Potential.** Specific areas underlain by sedimentary rock units for which little information is available are considered to have undetermined fossiliferous potentials. Field surveys by a qualified vertebrate paleontologist to specifically determine the potentials of the rock units are required before programs of impact mitigation for such areas may be developed.

If an area is determined to have a high potential for containing paleontologic resources, the SVP recommends that a program to mitigate impacts should be developed. In areas of high sensitivity, a preexcavation survey prior to excavation is also recommended to locate surface concentrations of fossils that might need special salvage methods.

During the development of a model curation program for Orange County, Eisentraut and Cooper (2002) developed a slightly more detailed sensitivity scale that is more graduated than the "high," "low," and "unknown" sensitivity ratings developed by the SVP (1995) for each formation that exists within Orange County. These sensitivities are based on the fossils that have (or have not) been recovered within each formation. However, Eisentraut and Cooper (2002) state that based on future findings, these ratings can and may change. The rating system by Eisentraut and Cooper (2002) is as follows:

- **Very High.** Scientifically very significant fossils and fossils from critical geologic time periods—very important for scientific study
- **High.** Quality preservation and scientifically significant fossils—important for research and/or very important for public display
- **Moderate.** Abundant fossils of good quality—important for education and public display
- **Low.** Poorly preserved fossils—only useful for educational purposes
- **None.** Contains no fossils; either too young or nondepositional rock units

According to the Department, significance is often stated as "sensitivity" or "potential." In most cases, decisions about how to manage paleontological resources must be based on this potential because the actual situation cannot be known until construction excavation for the project is underway. Significance may also be stated for a particular rock unit, predicated on the research potential of fossils suspected to occur in that unit. The Department uses the following tripartite scale:

- **High Potential.** Rock units which, based on previous studies, contain or are likely to contain significant vertebrate, significant invertebrate, or significant plant fossils. These units include but are not limited to sedimentary formations that contain significant nonrenewable paleontological resources anywhere within their geographical extent and sedimentary rock units temporally or lithologically suitable for the preservation of fossils. Areas with a high potential for containing significant paleontological resources require monitoring and mitigation.
- **Low Potential.** This category includes sedimentary rock units that (1) are potentially fossiliferous but have not yielded significant fossils in the past; (2) have not yet yielded fossils but possess a potential for containing fossil remains; or (3) contain common and/or widespread invertebrate fossils if the taxonomy, phylogeny, and ecology of the species contained in the rock are well understood. Sedimentary rocks expected to contain vertebrate fossils are not placed in this category. Rock units designated as low potential generally do not require mitigation monitoring.
- **No Potential.** Rock units of intrusive igneous origin, most extrusive igneous rocks, and moderately to highly metamorphosed rocks are classified as having no potential for containing significant paleontological resources. In addition, artificial fill falls into this category.

Given the range of criteria that may be used, significance assessments should necessarily be based on the recommendations of a professional Principal Paleontologist with expertise in the region under study and the resources found in that region. An evaluation of a particular rock unit's significance rests on the known importance of specific fossils. Often this significance is reflected as a sensitivity

METHODS

To ensure that research was comprehensive, the paleontological resources "study area" was expanded to include an area up to 100 ft beyond the basin dimensions shown on Figure 2. Prior to the field survey, research was conducted to locate fossil localities within the study area as well as sediments and formations conducive to the preservation of paleontological resources. This research involved review of available geological and paleontological literature concerning or related to the stratigraphy of the project area, requests for paleontological locality data from Southern California museums, and requests for locality data from paleontologists and geologists who have conducted research in the vicinity of the SR-91 CIP. The pedestrian survey, however, was limited to the basin locations where excavation is proposed.

Key Personnel

Brooks R. Smith, LSA Paleontologist, LSA Project Manager, and County of Orange Certified Paleontologist, completed the paleontological resource literature review and report preparation. Mr. Smith (Appendix C) has 16.5 years of experience with paleontological salvage programs and has extensive experience collecting paleontological resources as well as writing paleontological assessment reports; surveying for paleontological resources; salvaging large fossil specimens; fossil identification and curation; and final mitigation monitoring reports at the conclusion of construction projects.

This report was reviewed by Steven W. Conkling, a County of Orange Certified Paleontologist who has worked at LSA for 16 years. He has also prepared numerous paleontological assessment and mitigation monitoring reports. Mr. Conkling also worked as the Museum Director for Clark Interpretive Center, County of Orange, for seven years prior to joining LSA. He is a research associate or a member of several local museums and scientific societies, including the Orange County Natural History Museum, Los Angeles County Museum of Natural History (LACM), San Bernardino County Museum, Mojave Desert Quaternary Research Society, and SVP. Mr. Conkling's resume is included in Appendix C.

Meredith Staley, LSA Paleontologist, was the lead field surveyor for the project. Ms. Staley has been the director of the archaeology and paleontology laboratory for LSA's Irvine office for the past three years. Prior to coming to LSA, first as a student intern in 2001, then full time in 2003, she was a student curator at the paleontology lab at California State Polytechnic University, Pomona, for two years. In addition to working at LSA, Ms. Staley also works as a vertebrate paleontology preparator at the LACM. She has also volunteered as a preparator at the George C. Page Museum of La Brea Discoveries in Los Angeles. She has worked on all aspects of paleontology analysis while at LSA, including preparing assessment reports; surveys; mitigation monitoring; fossil salvage; fossil preparation, identification, and curation; and writing mitigation monitoring reports. Ms. Staley's resume is included in Appendix C

LITERATURE REVIEW AND RECORDS SEARCH

A paleontological literature review was conducted for the proposed project using unpublished reports, paleontological assessment and monitoring reports, field notes, published literature, and maps. A paleontological resource records search was conducted through the LACM. Paleontological resource locality forms housed in these institutions record fossil localities in sediments equivalent in age to these on the proposed project. As geologic formations and units can be exposed over large geographic areas but contain similar lithologies and fossils, the literature review and fossil locality search includes areas well beyond the study area.

The purpose of the locality search was to establish the status and extent of previously recorded paleontological resources within and adjacent to the project Area of Direct Impact (ADI). With this knowledge, LSA could make an informed assessment of the potential effects of the proposed project on paleontological resources and evaluate the types of fossils that might be uncovered during ground-disturbing activities. In addition, the sensitivity of the sediments expected to be encountered within the project could be determined.

Appendix D contains the locality search results.

FIELD INSPECTION

Pedestrian Survey

A pedestrian survey of the proposed project ADI was conducted by Paleontologist Meredith Staley on December 31, 2008, and January 5, 2009. Ms Staley examined only the basins where excavation is proposed, paying special attention to areas where bedrock might be exposed in existing cuts or in rodent burrows.

The purpose of this survey was to confirm the accuracy of the geologic mapping and to identify whether any paleontological resources might be exposed on the surface. In this way, LSA could document the existence of paleontological material prior to the beginning of ground-disturbing activities and locate areas within the project that might contain abundant remains.

RESULTS

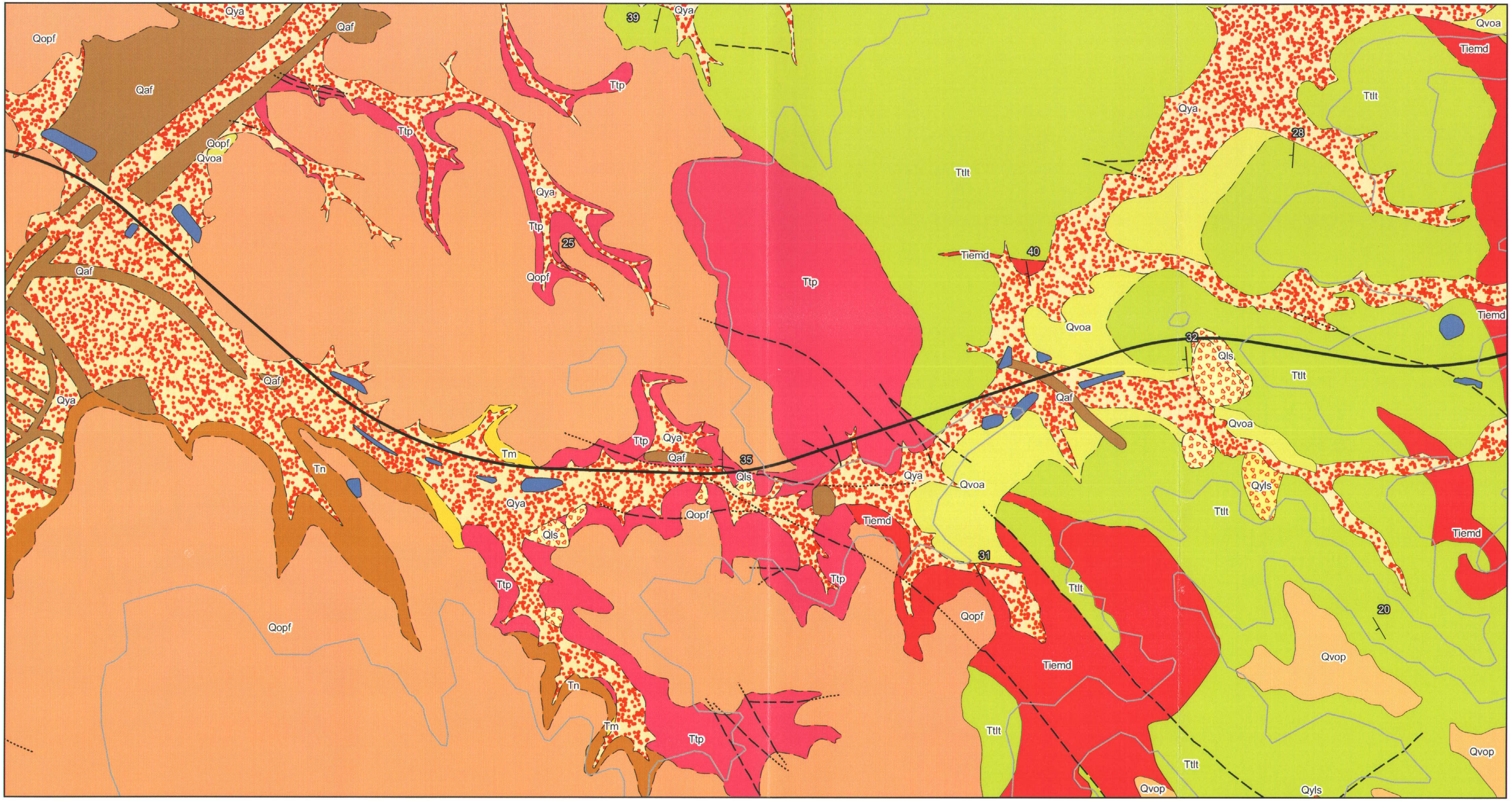
LOCALITY SEARCH

Geology

The proposed SR-73 Basins project is located at the northern end of the Peninsular Range geomorphic province, a 900-mile-long northwest-southeast-trending structural block that extends from the tip of Baja California to the Transverse Ranges and includes the Los Angeles Basin (Norris and Webb, 1976). The total width of the province is approximately 225 miles, with a maximum landbound width of 65 miles (Sharp, 1976). It contains extensive pre-Cretaceous (more than 65 million years ago) igneous and metamorphic rocks covered by limited exposures of post-Cretaceous sedimentary deposits. Within Orange County, these post-Cretaceous sedimentary deposits are believed to be some of the most important Tertiary marine fossil-producing areas in the world due to the completeness of the geologic record and general abundance of the fossils (Raschke, 1984). Belyea and Minch (1989) report that the Santa Ana Mountains contain exposures of the most complete section of Late Mesozoic and Cenozoic (approximately 150 million years ago to the present) stratigraphy in the entire Peninsular Ranges.

Specifically, the project is located within the San Joaquin Hills. The San Joaquin Hills are a coastal extension of the Santa Ana Mountains and the westernmost range of the Peninsular Ranges Geomorphic Province (Barrie et al. 1992). The hills extend across approximately 90 square miles, including a 12-mile stretch of rugged coastline. Exposed formations have a combined thickness of 22,000 ft and range in age from the Paleocene to the Late Pleistocene (63 million–10,000 years) (Vedder, 1970). The hills consist of both marine and terrestrial sediments and intrusive igneous rocks. This mix of resistant igneous intrusives and soft to resistant sedimentary rock creates a terrain that is variously rugged or gently sloped, depending on the underlying strata. The seaward-facing hills adjacent to the coast have been shaped by a series of Pleistocene marine terraces and conventional erosion. The inland-facing portions of the hills have been shaped only by conventional erosion.

Geologic mapping (Morton and Miller, 2006 and Morton, 2004) indicates that sediments from the Sespe Formation, the Undifferentiated Topanga Formation, the Bommer Member of the Topanga Formation, the Los Trancos Member of the Topanga Formation, the Monterey Formation, the Capistrano Formation, Marine Terrace Deposits, nonmarine Terrace Deposits, landslides, and young alluvium are mapped as occurring at least one basin location (Figure 3). Table A lists the ages for the formations and units exposed within the study area. These units are described in more detail below.



Stormwater Basin
Centerline SR-73
Sedimentary bedding, inclined

Contact, approx. located
Contact, certain
Fault, approx. located
Fault, certain
Fault, concealed
Fault, inferred

*Map units within study area
Qaf-Artificial fill
Qya-Young alluvium
Qyls-Young landslide deposit
Qvoa-Old alluvium
Qopf-Marine terrace deposits

Tcs-Capistrano Formation
Tm-Monterey Formation
Tt-Topanga Formation
Ttlt-Topanga Formation, Los Trancos member
Ttb-Topanga Formation, Bommer member
Ts-Sespe Formation

0 500 1,000 Feet

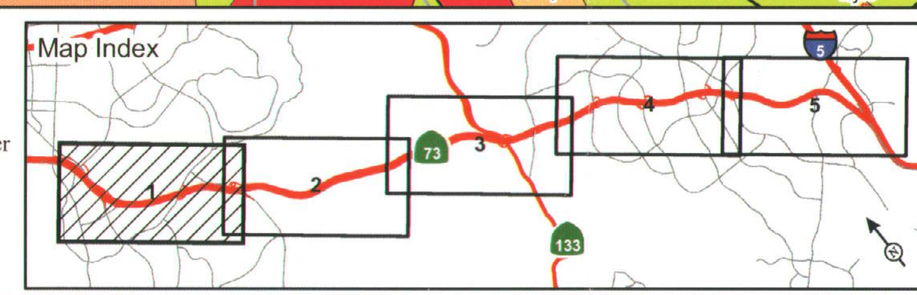


FIGURE 3
Sheet 1 of 5

SR-73 Basin Sedimentation Project

Geology Map

EA# 0H4400
12-ORA-73 PM 10/24.5

SOURCE: Morton (2004)
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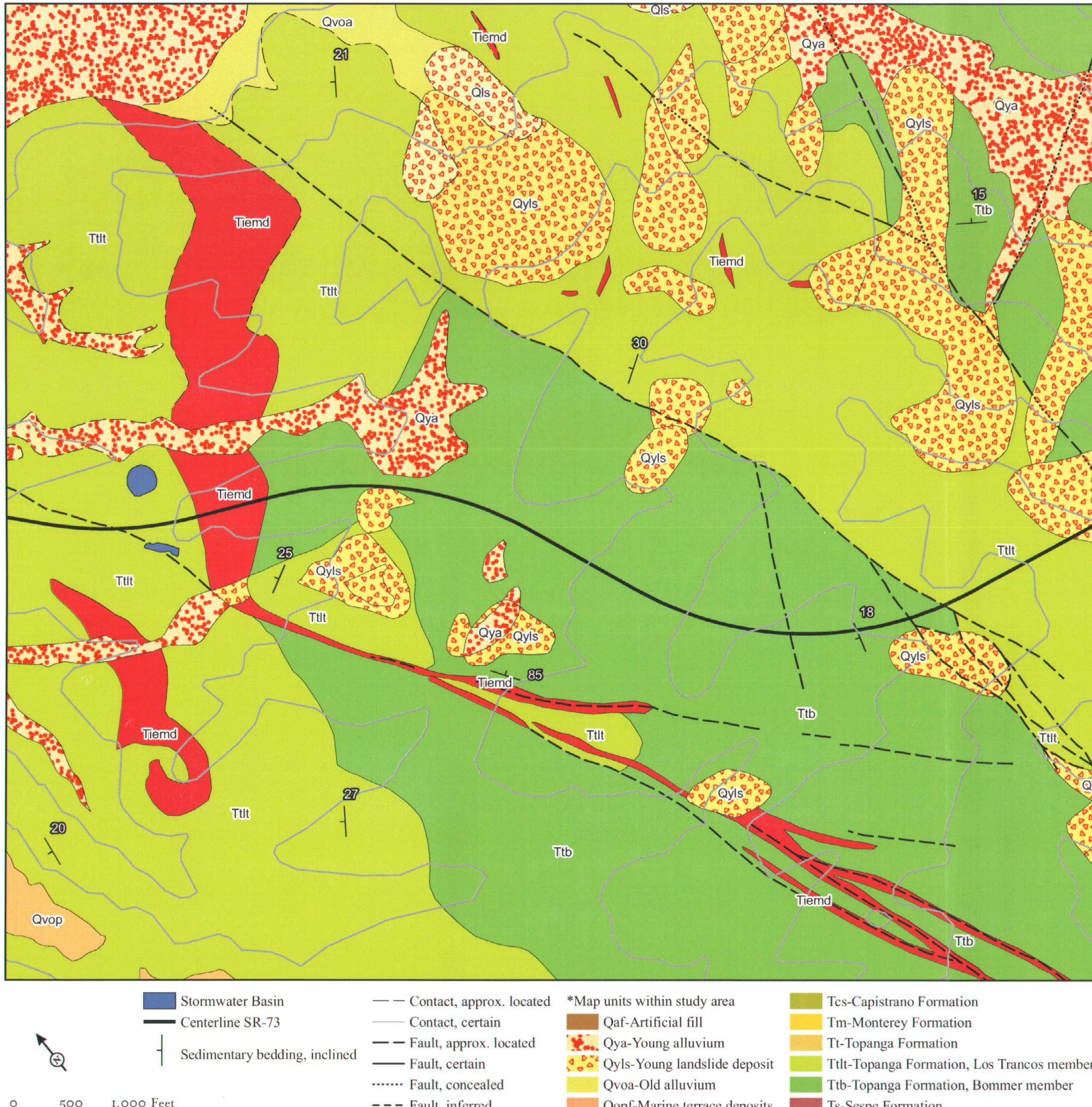

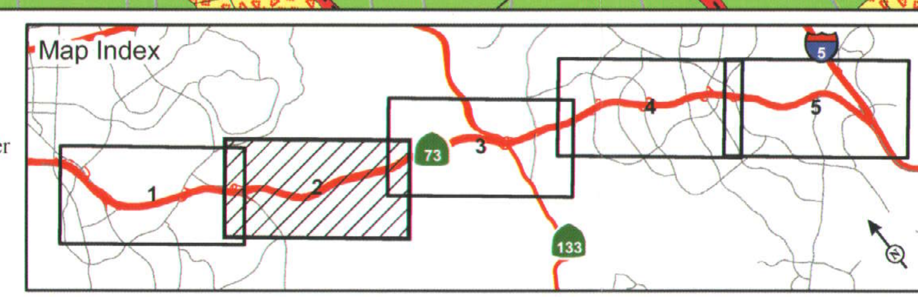

SOURCE: Morton (2004)

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FIGURE 3

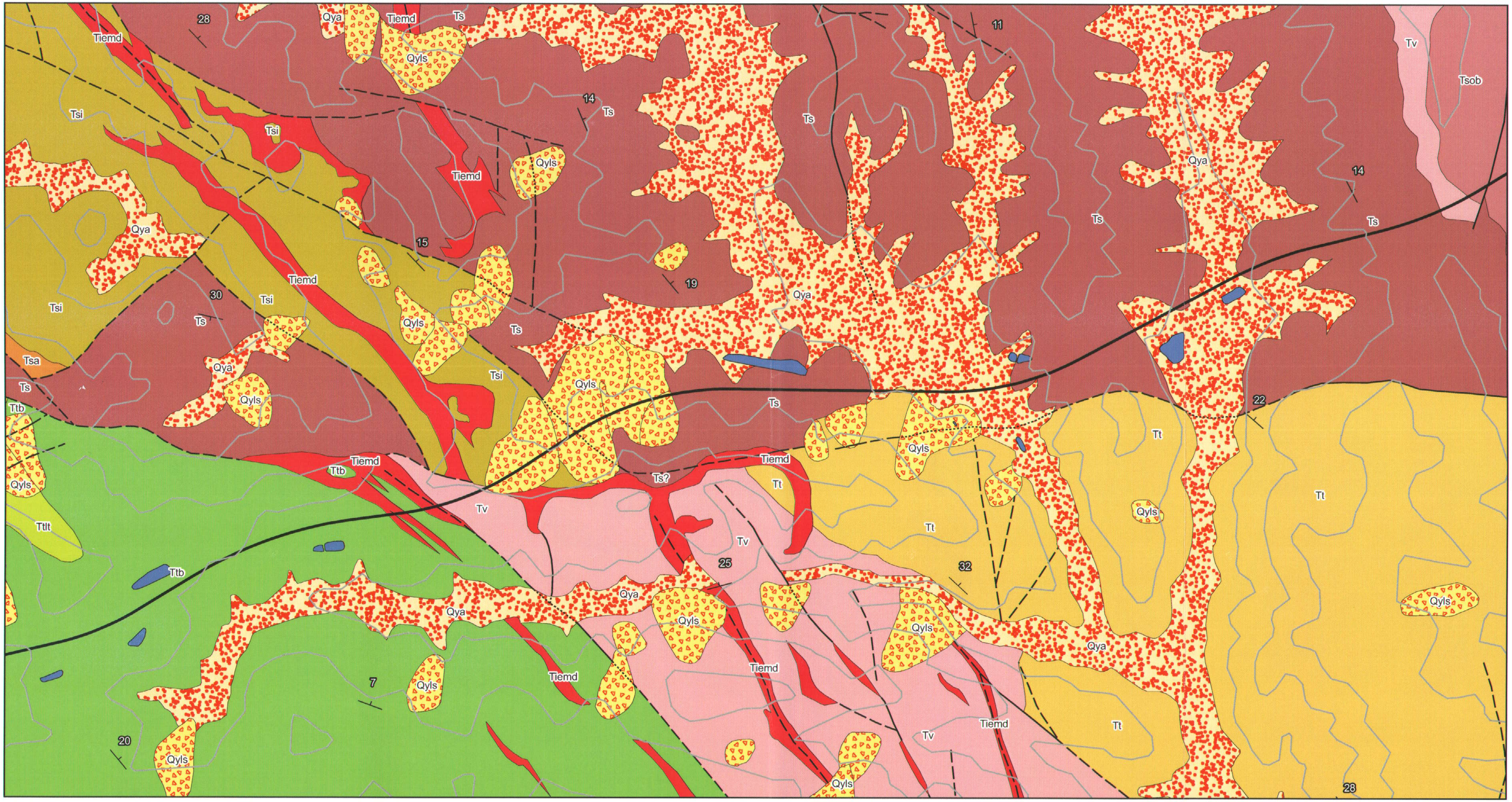
Sheet 2 of 5

SR-73 Basin Sedimentation Project

Geology Map

EA# 0H4400

12-ORA-73 PM 10/24.5



Stormwater Basin
Centerline SR-73
Sedimentary bedding, inclined

0 500 1,000 Feet

Contact, approx. located
Contact, certain
Fault, approx. located
Fault, certain
Fault, concealed
Fault, inferred

*Map units within study area
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Qya-Young alluvium
Qyls-Young landslide deposit
Qvoa-Old alluvium
Qopf-Marine terrace deposits

Tcs-Capistrano Formation
Tm-Monterey Formation
Tt-Topanga Formation
Ttlt-Topanga Formation, Los Trancos member
Ttb-Topanga Formation, Bommer member
Ts-Sespe Formation

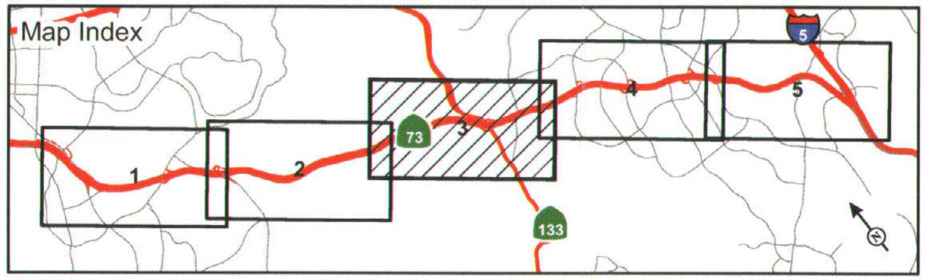

FIGURE 3
Sheet 3 of 5

SR-73 Basin Sedimentation Project

Geology Map

EA# 0H4400
12-ORA-73 PM 10/24.5

SOURCE: Morton (2004)

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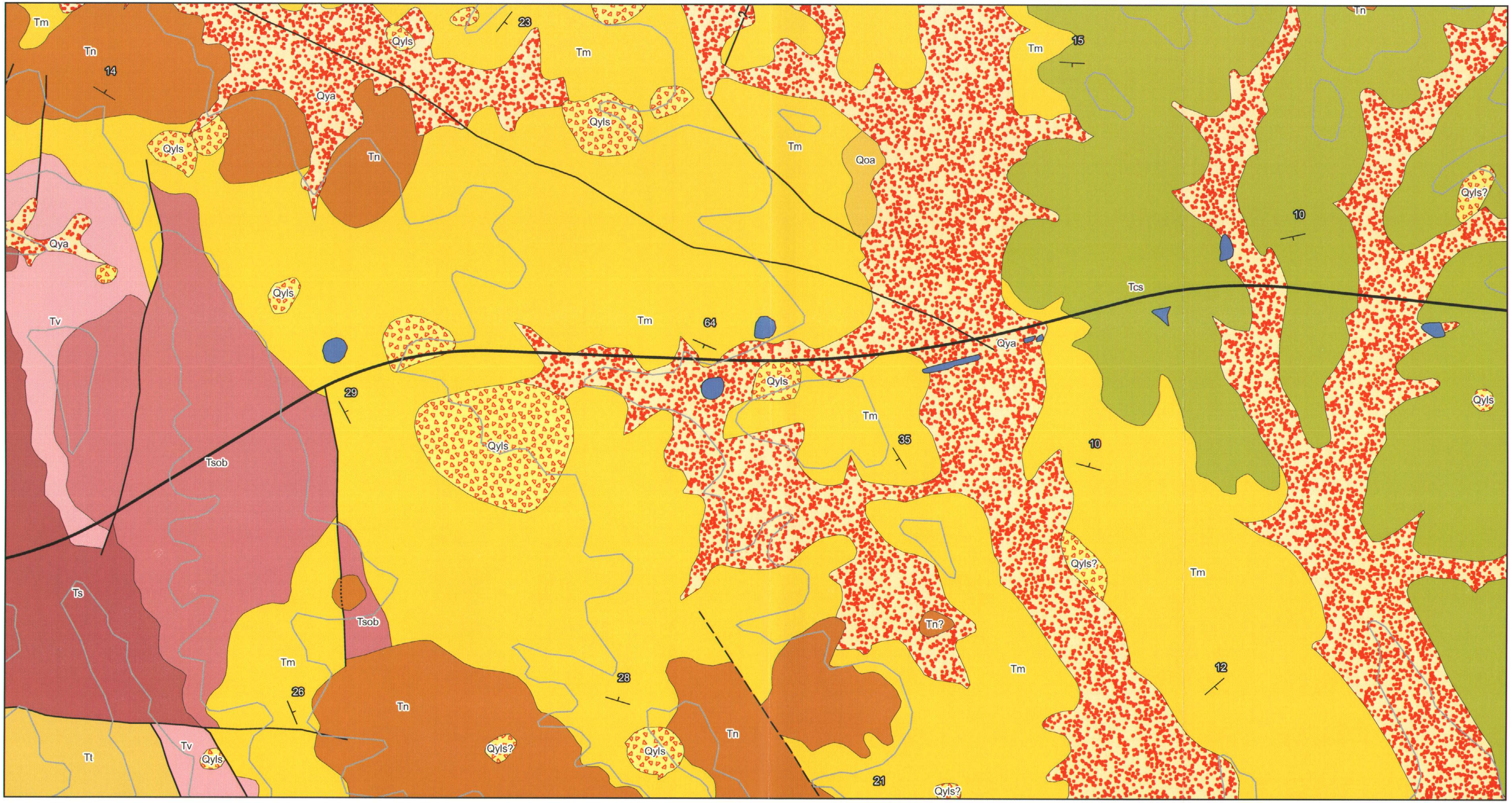

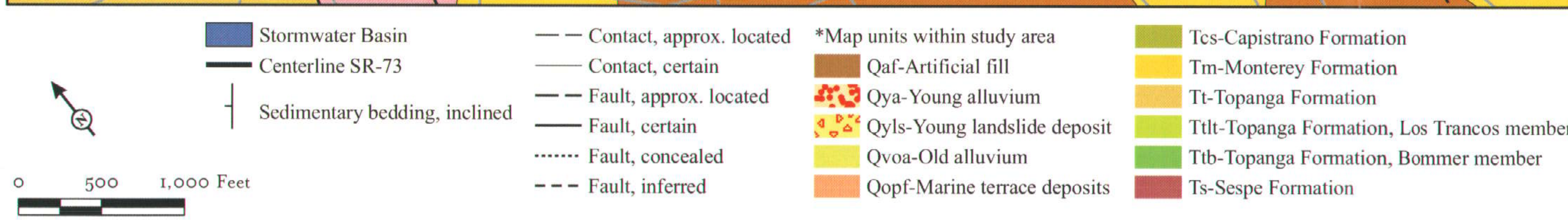

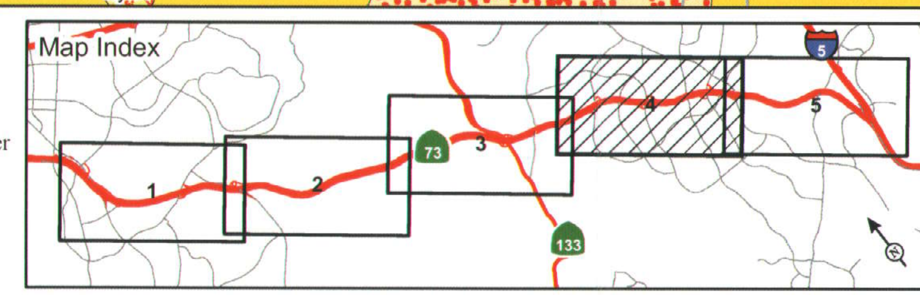

FIGURE 3

Sheet 4 of 5

SR-73 Basin Sedimentation Project

Geology Map

EA# 0H4400

12-ORA-73 PM 10/24.5

SOURCE: Morton (2004)

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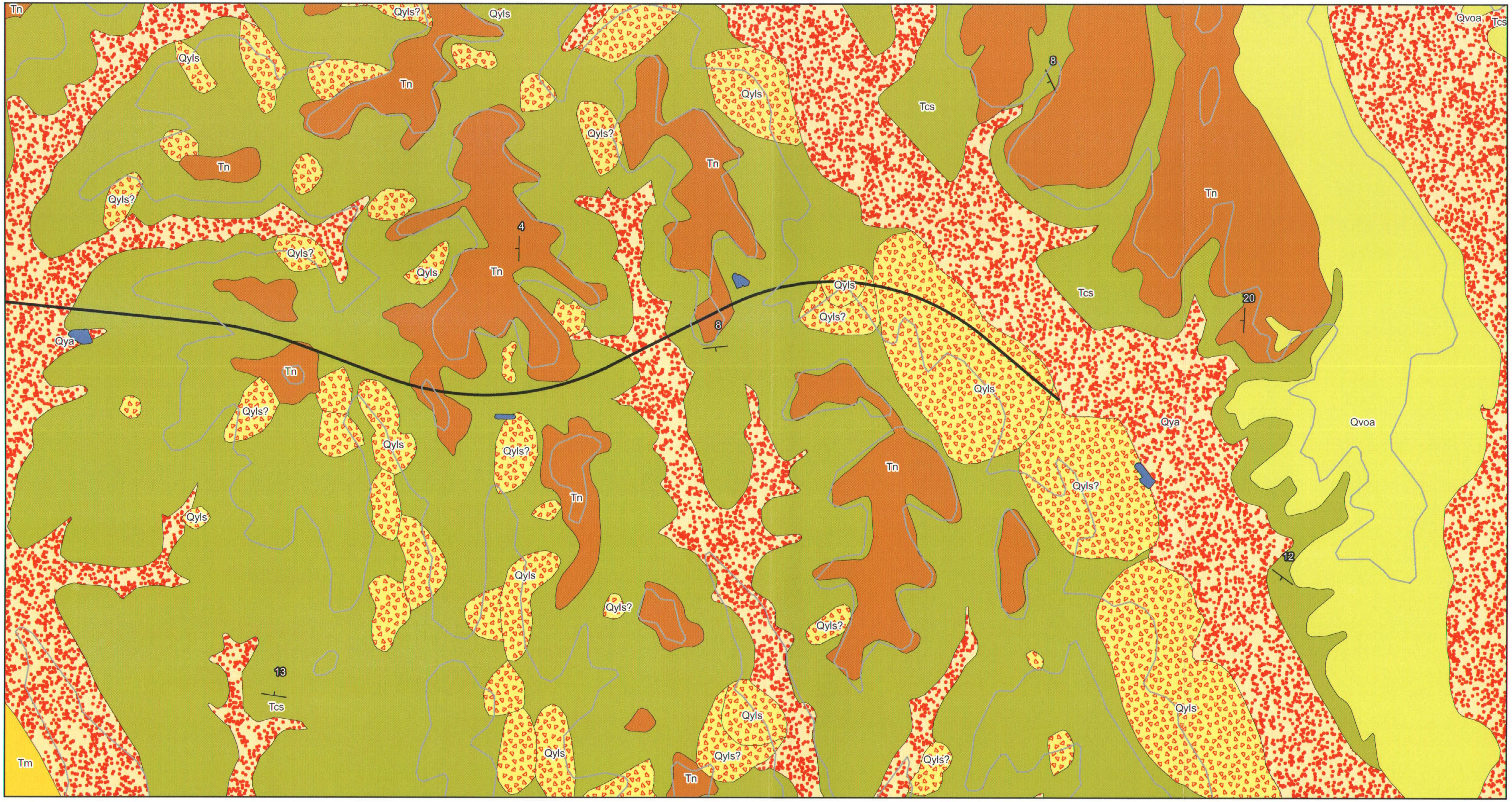

Stormwater Basin
Centerline SR-73
Sedimentary bedding, inclined

0 500 1,000 Feet

SOURCE: Morton (2004)
I:\CDT0807\GIS\Geology.mxd (1/14/2009)

Contact, approx. located
Contact, certain
Fault, approx. located
Fault, certain
Fault, concealed
Fault, inferred

*Map units within study area
Qaf-Artificial fill
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Qyls-Young landslide deposit
Qvoa-Old alluvium
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Tcs-Capistrano Formation
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Tt-Topanga Formation
Ttlt-Topanga Formation, Los Trancos member
Ttb-Topanga Formation, Bommer member
Ts-Sespe Formation

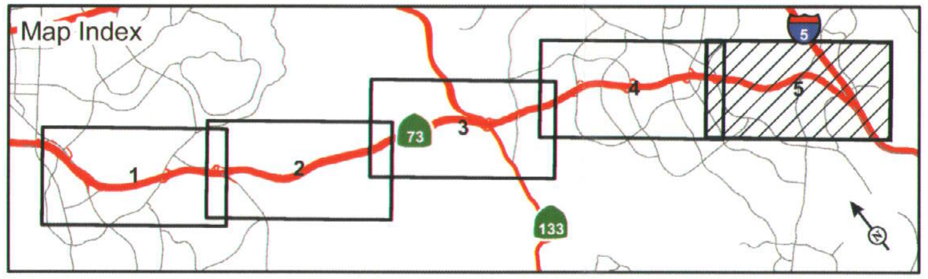

FIGURE 3
Sheet 5 of 5
SR-73 Basin Sedimentation Project
Geology Map
EA# 0H4400
12-ORA-73 PM 10/24.5

Table A: Geologic Time Periods and Geologic Units within the Study Area

Epoch	Age (years)	Geologic Formation/Unit	Map Symbol
Quaternary Period			
Holocene	Less than 100 years	Artificial Fill	Qaf
Holocene	Less than 10,000	Young Alluvium	Qya
Holocene	Less than 10,000	Quaternary Landslides	Qls
Pleistocene	10,000–1.8 million	Older Alluvium	Qvoa
	80,000 – 1.2 million	Marine Terrace Deposits	Qtm
Tertiary Period			
Late Miocene to Early Pliocene	3–7 million	Capistrano Formation – Siltstone Member	Tcs
Middle Miocene	7–13.5 million	Monterey Formation	Tm
Middle Miocene	13.5–17 million	Topanga Formation – Undifferentiated	Tt
Middle Miocene	15-16	Topanga Formation – Los Trancos Member	Ttlt
Middle Miocene	16-17	Topanga Formation – Bommer Member	Ttb
Early to Middle Miocene	17.5-20	Sespe Formation and Undifferentiated Sespe/Vaqueros Formation	Ts and Tvs

Sespe Formation. The Sespe Formation is considered Late Oligocene (Arikareean) to early Miocene, although some authors have suggested a Late Eocene age for some Sespe sediments. Based on fossils recovered from the Laguna Canyon area, the age of the Sespe is somewhat younger, at between 17.5 and 19.5 million (Smith, et al., 2008), approximately 10 million years younger than the Sespe Formation in the type location in Simi Valley. In general, it consists of terrestrial sediments; however, because of its interbedding with the marine Vaqueros Formation, marine fossils are sometimes found within typical Sespe red beds. Sediments from the Sespe Formation are light red to pale orange and pale yellow gray to light gray coarse-grained sandstone; medium-coarse grained, silty, and clayey sandstone; and conglomeratic sandstone. The sandstone beds are mostly quartzo-feldspathic and locally biotite rich. The conglomerate clasts are usually well-rounded, multicolored siliceous porphyry and welded turf. Bedding ranges from poor to well, and the formation is commonly cross-bedded.

The Sespe Formation was defined by Watts (1897) in the area of Sespe Creek in the Transverse Ranges, near Filmore in Ventura County, approximately 90 miles to the northwest. Morton (1970) reports that it reaches a thickness of 1,500 ft in the southern Santa Ana Mountains. It has a gradational contact with the underlying Santiago Formation and a gradational (and, in some areas, interfingering) contact with the overlying Vaqueros Formation. In the northern Santa Ana Mountains and some areas of the San Joaquin Hills, it is correlated with the nonmarine facies of the undifferentiated Sespe/Vaqueros Formation.

Undifferentiated Sespe/Vaqueros Formation. The undifferentiated Sespe/Vaqueros Formation will also be discussed here as work done by LSA during monitoring associated with construction of SR-73 showed that exposures in the San Joaquin Hills that are crossed by SR-73 are more typical of the undifferentiated Sespe/Vaqueros Formation than simply the Sespe Formation (Conkling, et al., 1997).

The undifferentiated Sespe/Vaqueros Formation represents an interfingering of the Sespe Formation (nonmarine) and Vaqueros Formation (marine). Schoellhamer (1981) viewed the Vaqueros and Sespe Formations as contemporaneous units by their interfingering. Sespe/Vaqueros units are composed of a varied sequence of interbedded marine and nonmarine sandstones and conglomerate. Recent work (Lander, 1994, and Dave Whistler, pers. comm.) indicates that some red beds, previously referred to the Sespe Formation, contain marine faunas.

The undifferentiated Sespe/Vaqueros Formation is distinguished from the Sespe and Vaqueros Formations in the San Joaquin Hills and in the southern Santa Ana Mountains beginning approximately two miles south of Mojeska Canyon. The units range from 300 to 900 meters (m) (985–2,952 ft) thick within the Santa Ana Mountains. Within the San Joaquin Hills, this formation has been measured at over 2,200 ft (Conkling, et al., 1997). The Sespe/Vaqueros Formation overlies the Santiago Formation. Regarding the upper contact of this unit with the overlying Topanga, the comments of Schoellhamer et al. (1981) are of special note:

> "The contact between the undifferentiated Sespe and Vaqueros Formations and the overlying Topanga Formation usually is easily recognized where the basal beds of the Topanga are fossiliferous conglomerate. The upper beds of the undifferentiated Sespe and Vaqueros, consisting of greenish-gray sandstone and silty sandstone and pinkish and reddish-brown sandstone contrast sharply with the overlying buff and tan massive conglomeratic sandstone of the Topanga. No evidence of an angular discordance between the Topanga and the underlying strata was found in the map area. The Topanga rests on various rock types of the Sespe and Vaqueros, probably as a result of changes from marine to nonmarine deposition within the Sespe and Vaqueros rather than of erosion prior to deposition of the Topanga."

Howard (1995) interpreted the sediments of the Sespe Formation as being derived from fluvial deltaic sources. The sequence varies as interbedded and interfingering marine and nonmarine claystones, siltstones, sandstones, and conglomerates. The nonmarine sequences are typically maroon to reddish in color and are primarily siltstones and claystones with varying amounts of sand. Marine sequences are typically light yellow-brown to grayish sandstones and conglomerates with occasional siltstone and claystone beds. Some sandstone and conglomerate beds may have been deposited by alluvial fans (Howard, 1995). Because of the interfingering, regional correlation of the undifferentiated Sespe/Vaqueros Formation is difficult. Beleya and Minch (1989) stated that abrupt facies changes and lateral discontinuity hinder correlation of the undifferentiated Sespe/Vaqueros Formation within the northern Santa Ana Mountains.

The depositional environment for the undifferentiated Sespe/Vaqueros Formation is one of a transitional zone between a generally braided/meandering river alluvial plain (the "Sespe Formation" of Belyea and Minch, 1989) and a shallow sea (the "Vaqueros Formation" of Belyea and Minch, 1989). Belyea and Minch (1989) propose that the basal portion of the Sespe Formation represents braided river deposits with low sinuosity containing locally derived, sand-dominated sediments. Belyea and Minch (1989) discuss a marker bed from higher up in the section that can be traced south from Gypsum Canyon to Santiago Creek to the Aliso Divide and to El Toro Road in the San Joaquin Hills. This marker bed was theorized to represent the following environments (from north to south): a torrential channel fill, a floodplain, a sabka/lagoon, and deltaic deposits. Toward the top of the section, the sediments suggest the progradation of nonmarine fluvial deposits into a marine basin (Belyea and Minch, 1989). At the very top of the section, as described by Belyea and Minch (1989), the continental Sespe Formation deposits interfinger with the marine Vaqueros Formation.

Topanga Formation. The Middle Miocene, marine Topanga Formation is divided into four units: the undifferentiated Topanga Formation (Tt), the Bommer Member (Ttb), the Los Trancos Member (Ttlb), and the Paularino Member (Ttp). The Bommer, Los Trancos, and Paularino Members are distinguished from the undifferentiated Topanga Formation only in the northern to central San Joaquin Hills. The undifferentiated Topanga, the Bommer Member, and the Los Trancos Member are all exposed within the project area.

The Topanga Formation was first defined by Kew (1923) from a predominantly sandstone sequence in Topanga Canyon of the Santa Monica Mountains. It has been identified as Middle Miocene by the presence of the *Turritella ocoyana* fauna of that age. The Topanga Formation is predominantly a sandstone sequence containing interbedded shales. The formation rests disconformably on the Sespe and Vaqueros Formations and is overlain by the El Modeno Volcanics and the Puente and Monterey Formations (Schoellhamer, et al., 1981). Schoellhamer, et al. (1981) contends that the contact between the basal conglomerate and the underlying undifferentiated Sespe/Vaqueros Formation is angular in the Northern Santa Ana Mountains. The basal unit of the Topanga Formation within the northern Santa Ana Mountains is described as a conglomerate. This unit ranges from tan to gray and ranges in thickness from 7 to more than 30 ft. The conglomerate is erosion-resistant and well cemented. Within this unit, marine mollusks, including large pectinids (scallops) and oysters, are common (Schoellhamer, et al., 1981).

Undifferentiated Topanga Formation. In general, the undifferentiated Topanga Formation consists of yellowish-gray, yellow-brown to light brown silty sandstone interbedded with conglomerate and olive-gray siltstone to sandy siltstone. Quartz and feldspar dominate the sand composition. The upper beds contain a predominant amount of western bedrock detritus (mainly schists), while the lower beds contain a predominant amount of eastern bedrock detritus (metavolcanics, metasedimentary and granitic type rocks). Sand grains range from angular to subrounded. Pebbles are subrounded to rounded, and cobbles are subangular to subrounded, generally thickly bedded but locally thin–medium bedded. Thicknesses range from 800 ft in the Puente Hills to 2,500 ft in the northern Santa Ana Mountains, 500 ft in the southern Santa Ana Mountains (Morton, et al., 1976), and 300 ft in the southern San Joaquin Hills (Vedder, 1970).

Bommer Member of the Topanga Formation. The Bommer Member of the Topanga Formation was deposited in a marine environment during the Middle Miocene. It is yellow-gray to yellow-brown, medium- to coarse-grained sandstone containing conglomerate lenses interbedded with olive-gray siltstone and fine grained sandstone. Sand grains are subangular to rounded and primarily quartz or feldspar. Pebbles are subrounded to rounded and mainly derived from the plutonic and acidic volcanic locks of the eastern bedrock complex. This unit is moderately well cemented, with some friable sandstone and soft siltstone interbeds. Bedding is commonly thick and broadly lenticular, with local thinly bedded horizons.

Thickness has been estimated to be as much as 2,400 ft (Vedder, 1970). It has a gradational contact with the underlying Vaqueros Formation and the overlying Los Trancos Member. It is exposed in the central portion of the San Joaquin Hills and correlates with part of the undifferentiated Topanga Formation. It contains abundant Middle Miocene faunal, including bivalves, gastropods, and barnacles.

The terrestrial plant remains that are found within the Bommer Member indicate that the paleoenvironment at this time was a warm Mediterranean-type climate similar to the conditions along the Pacific coast of Mexico today. The environments range from riparian floodplain (*Persea* sp., *Platanus* sp., *Typha* sp., *Salix* sp., and *Sabilites* sp.) to oak woodland (*Quercus* sp). Currently, avocados and palms do not grow wild along the coast of Southern California, as they do in Mexico, because of an incompatible climate. A suitable environment for their growth exists along the southern coast of the Mexican State of Sonora. Here rainfall is a minimum of 25 inches per year, many streams run year-round, the summers are wet and the winters are frost-free.

Los Trancos Member of the Topanga Formation. The Los Trancos Member was deposited in a marine environment during the Middle Miocene. It consists of medium to dark gray, light brown, brownish to light olive-gray siltstone and fine-grained sandstone. It also contains interbeds of shale and medium- to coarse-grained sandstone. Sandstone grains are subangular to subrounded. Bedding is well developed in the siltstone, ranging from thin to medium. Sandstone is predominantly thickly bedded. The siltstone tends to be soft, while the sandstone interbeds are resistant and well-cemented.

Vedder (1970) estimates the maximum thickness to be 3,100 ft in the Coyote Canyon area. The Los Trancos Member has a gradational contact with the underlying Bommer Member and an unconformable, but locally interfingering, contact with the overlying San Onofre Breccia. It also has a conformable contact with the overlying Paularino Member of the Topanga Formation; however, local unconformities may exist. It correlates, in part, to the San Onofre Breccia. It is exposed in the central and north central San Joaquin Hills.

Monterey Formation. The Monterey Formation is a well-studied rock unit that is found along the west coast of North America. It was named after exposures near Monterey, California, a little over 300 miles to the northwest of the study area. It is famous for its rich petroleum reserves that were formed from the abundant organic matter, primarily microscopic diatoms, contained within the sediments. In general, the Monterey Formation is composed primarily of deep marine deposits of diatomite, diatomaceous siltstone, mudstone, dolostone, and chert. The upper section of the marine Monterey Formation is Middle to Late Miocene (Luisian and Mohnian) and possibly older in the lower section (Morton et al., 1974). South of the Orange/San Diego County line, Ehlig (1979) reports that the basal Monterey consists of conglomerates and coarse-grained sandstones derived from the underlying San Onofre Breccia. Sandstone and siltstone can range from thinly to massively bedded. Some of the shale contains very thin, well-developed bedding that is locally rhythmic.

Locally, along the coastline, the Monterey Formation is approximately 1,200 ft thick, thinning to 300 ft as it moves inland (Smith, 1960). It unconformably overlies the Sespe, Vaqueros, San Onofre Breccia, and Topanga Formations. Locally, however, it has a gradational and interfingering contact with the San Onofre Breccia. It has a gradational contact with the overlying Capistrano Formation east of Oso Creek; elsewhere, it is unconformably overlain by the Niguel Formation, Marine Terrace Deposits, and nonmarine terrace deposits. It is widespread in the southern coastal ranges of California, but in Orange County is exposed only in the southern portion of the County.

It correlates with the parts of the Puente Formation in the central to northern Santa Ana Mountains and Puente Hills of Orange County and the Modelo Formation of Los Angeles County. Vedder et al. (1957) have made an arbitrary boundary between the Monterey and correlative members of the Puente. East of the Cristianitos Fault, Oso Creek is the boundary; west of the Cristianitos Fault, a general east-west line from near Lambert Reservoir to the Cristianitos Fault is the boundary.

The Capistrano Formation. The Capistrano Formation is a Late Miocene to Early Pliocene marine deposit that was named by Woodford (1925) for exposures in the vicinity of San Juan Capistrano. It was deposited in an ancient marine embayment of moderate depths. The formation is composed of a thick marine succession of mudstone, shale, siltstone, and minor silty sandstone and concretion layers. It has been divided into three distinct members: a Siltstone Member, a primarily sandy member known as the Oso Member, and a Turbidite Facies. The member exposed within the project area is the Siltstone Member.

The Siltstone Member is yellowish-gray to medium-brownish-gray concretionary siltstone and mudstone, with lenticular whitish-gray sandstone and thin calcareous mudstone interbeds. This member can be locally diatomaceous and tuffaceous, and may contain breccia or conglomerate at its base (Morton et al., 1976). The Siltstone Member of the Capistrano Formation is mostly poorly bedded to massive and has a maximum thickness of approximately 2,400 ft (Yerkes et al., 1965). It appears to have a gradational contact with the underlying Monterey Formation in most areas and an unconformable contact west of Oso Creek. The contact with the overlying Niguel Formation has a marked unconformity except in upper Newport Bay. It grades laterally into the Oso Member of the formation and is unconformably overlain by the turbidite facies of the formation.

Quaternary Marine Terrace. The Quaternary (80,000 to 1,230,000 YBP [Barrie et al., 1992]) Marine Terrace deposits consist of light brown, orange-brown, and yellow-brown to gray mixtures of sands, gravels, and pebbles with some minor silt. The sand grains tend to be subangular to subrounded while the gravels and pebbles are generally subrounded to rounded, with occasional angular clasts derived from the underlying formation. Bedding is usually poor; however, lenticular beds and cross-bedding do occur. The deposits tend to be friable to weakly indurated. Sand grains are predominantly quartz and feldspar, while the gravels are quite variable, including plutonics, volcanics, metamorphics, and fragments of the underlying, or nearby, bedrock formations.

Vedder (1970) states that some of the Marine Terrace deposits can be as thick as 125 ft; however, Barrie et al. (1992) encountered terrace deposits only up to 59 ft thick, and geologic work conducted prior to construction of the San Joaquin Hills Transportation Corridor encountered terrace deposits up to 85 ft thick before drilling was ended (Geofon and Zeiser, 1989). These deposits unconformably overlie Pliocene and Miocene Formations in all areas and are unconformably overlain by Quaternary to recent colluvial deposits. To date, seven marine terraces have been identified within the San

Joaquin Hills (Table B) (Barrie et al., 1992). Terraces 1 and 2 are both exposed within the project area.

Table B: Pleistocene Marine Terraces in Orange County

Terrace	Age (years before present)	Elevation (amsl) feet
Terrace 1	80,000	52
Terrace 2	125,000	108
Terrace 3	210,000	164
Terrace 4a	320,000	328
Terrace 4b	395,000	328
Terrace 5	695,000	475
Terrace 6	1,050,000	787
Terrace 7	1,230,000	984

Source: From Barrie et al., 1992.
amsl = above mean sea level

Older Alluvium. Older alluvium is an alluvial deposit older than 10,000 years and is often called a nonmarine terrace deposit, as it is often the sediment contained within the stream terraces that is above, and flank, the active stream channel. However, these sediments can also be found at depths below the active stream channel. These deposits consist of interbedded silt, clayey sand, and conglomeratic coarse-grained sands. Colors can vary from light yellows to browns and reds. The sand grains are generally subangular to subrounded, while the gravels and cobbles are rounded to well rounded.

Landslide Deposits. These areas consist of blocks and flows of the underlying sediments. They formed during the last two million years as canyon cutting and aqueous erosion caused slope failure. Their composition is dependent on the underlying sediments that have slid. Sometimes they are no deeper than several feet and only involve movement of soil. However, sometimes they are massive, covering several acres with ruptures tens of feet deep extending well into the underlying bedrock.

Young Alluvium. Young alluvium, also known as recent alluvium, can range in age from Recent to Latest Pleistocene. It is similar to older alluvium, but is usually located closer to an active stream channel. These deposits consist of loosely consolidated gravel, sand, and silt ranging from poorly sorted to well sorted, composed of mainly quartz, but also containing feldspar and biotite. The sand grains are generally subangular to subrounded, while the gravels and cobbles are rounded to well rounded. Color is usually yellow-brown to gray-brown, and is somewhat dependent on the nearby, or upstream, geology.

Artificial Fill. Artificial fill was not mapped within the project area on the geology map (Morton and Miller, 2006 and Morton, 2004) in all the areas where it occurs; however, due to the project being located in a developed area, it does occur in many locations. Artificial fill consists of sediments that have been removed from one location and transported to another by humans. Sometimes the transportation distance can be a few meters (a few feet) to dozens of kilometers (dozens of miles). Composition is dependent on the source. When it is compacted and dense, it is known as "engineered fill," but it can be unconsolidated and loosely compacted. Artificial fill will sometimes contain modern debris such as asphalt, wood, bricks, concrete, metal, glass, plastic, and even plant material. Depending on the area, thickness can be less than 1 ft or several hundred feet.

Paleontology

Undifferentiated Sespe/Vaqueros Formation. Paleontological sites within these units are of the highest significance. In the San Joaquin Hills, during grading for SR-73, abundant vertebrate fossils of oreodonts, camels, rodents, and marsupials were recovered from the Sespe facies, some close to the location of the basins (Conkling, et al., 1997). During grading for the realignment and widening of Laguna Canyon Road 732, primarily small mammal, vertebrate fossils were recovered from two localities in the Sespe facies, approximately 3 miles to the north (Smith, et al., 2008).

Between 1988 and 2004, during paleontological mitigation monitoring within Frank R. Bowerman (FRB) Landfill, located approximately 9 miles to the northeast, numerous terrestrial vertebrates, including snakes, lizards, birds, mice, gophers, marsupials, squirrels, rabbits, camels, oreodonts, and a rare small canid, were collected from the Sespe facies (Morgan et al., 1991; Raschke, 1997, Conkling et al., 1998 and Smith and Conkling, 2005). Some of these finds are very rare and represent first finds for the County or extensions in the temporal ranges of the species. Within the Vaqueros facies of FRB Landfill, marine vertebrates, including whales; dolphins; sharks; rays; bony fish; and numerous invertebrates, including bivalves, gastropods, cephalopods, annelid worms, crabs, sand dollars, and barnacles, were collected during paleontological monitoring (Morgan et al., 1991; Raschke, 1997, Conkling et al., 1998; and Smith and Conkling, 2005).

In 1986–1987, RMW Paleo Associates discovered a large deposit of marine invertebrates and terrestrial and marine vertebrates during excavation for the Bee Canyon Access Road leading to FRB Landfill, approximately 9.5 miles to the northeast. These finds included gastropods, bivalves, barnacles, cetacean (whale), oreodont (early artiodactyl), subhyracodon rhino, proebrotheriid camel, and rodents (Raschke, 1988).

In 1991–1993, Paleo Environmental Associates, Inc. uncovered a large deposit of terrestrial and marine vertebrates from Santiago Canyon Landfill, approximately 13 miles to the north (Lander, 1994). These finds included sharks, rays, bony fish, frogs, snakes, lizards, tortoises, dogs, rabbits, shrews, hedgehogs, squirrels, mice, gophers, camels, oreodonts, deer, rhinoceros, and primitive three-toed horses. Many of these remains indicate an Arikareean North American Land Mammal Age for these sediments.

During grading for State Route 241 (SR-241), just over 15 miles to the northeast, Lander (2003) reported finding a diverse fauna, including turtles, lizards, snakes, marsupials, and mammals (including the first reported occurrence of a fossil primate from the County) from the terrestrial beds and gastropods, bivalves, fish, sharks, rays, a possible crocodile, and a possible desmostylid from the marine beds.

Schoellhamer, et al. (1981) report 27 named macrofossil localities within the undifferentiated Sespe/Vaqueros Formation in the northern Santa Ana Mountains that preserve a diverse fauna of invertebrates, including gastropods, bivalves, echinoderms, and barnacles and one vertebrate locality. The vertebrate locality, Cal Tech Locality S360, yielded mammalian bone fragments near Bolero Lookout, 10.5 miles to the northeast. These compared with, and are assumed to represent, proebrotheriid camels (Schoellhamer, et al., 1981). Schoellhamer, et al. (1981) also identified numerous other localities within the undifferentiated Sespe/Vaqueros Formation; however, only the locations are plotted, and no information on what was observed/collected is given.

Topanga Formation. The Topanga Formation has produced a rich fossil assemblage. Eisentraut and Cooper (2002) state that the Topanga has produced an abundance of fossils, including invertebrate, plant, and vertebrate fossils such as shark teeth, whales, sea cows, sea lions, and sharks. The following is a brief summary of some of the fossil discoveries within the Topanga members that will be encountered:

Undifferentiated Topanga. Abundant fossils have been found in the undifferentiated Topanga Formation, including bivalves, gastropods, barnacles, echinoderms, and marine and terrestrial plants. Marine mammals such as seals, sea lions, walruses, desmostylans, whales, dolphins, and sea cows are also well documented from this formation, as are sharks, rays, bony fish, rodents, and birds. During grading for SR-241, Lander (2003) recovered a rodent, several species of marine mammals, fish, sharks, rays, crabs, and mollusks from this formation. Schoellhamer, et al. (1981) report 33 macrofossil localities within this unit in the northern Santa Ana Mountains that include a diverse genera of invertebrates such as gastropods, bivalves, echinoderms, and barnacles. In 1991, John Minch and Associates found a bone bed in the northern Santa Ana Mountains that contained a large number of marine mammals such as cetaceans and pinnipeds, as well as marine vertebrate remains such as shark teeth and bat ray tooth plates. Some fossil localities were recorded close to the outcrop area for the undifferentiated Topanga Formation during mitigation monitoring of grading for SR-73 (Conkling et al., 1997).

Bommer Member of the Topanga. This member contains abundant fossil remains from plants, invertebrates, and marine and terrestrial vertebrates. Plant remains include: avocado (*Persea* sp.), sycamore (*Platanus* sp.), oak (*Quercus* sp.) willow (*Salix* sp.), cattail (*Typha* sp.), and palm (*Sabilites* sp.), some of which were collected by John Minch and Associates during grading for SR-73 (JMA, 1995). Invertebrate remains include bivalves, gastropods, echinoderms, crabs, and barnacles, many of which were collected during grading along SR-73 by John Minch and Associates (JMA, 1995) and LSA (Conkling et al., 1997). According to Vedder (1970), *Turritella ocoyana* and *T. temblorensis*, indicator species for the Middle Miocene, are the most widespread gastropods found within the Bommer Member. Vertebrates mainly include bones and teeth from fish and sharks (JMA, 1995; and Conkling et al., 1997) but also occasionally rare terrestrial fossils such as the Miocene camel *Protolabis* sp. that was collected during grading for SR-73 (Conkling et al., 1997). Several fossil localities are recorded very close to some of the basins in the outcrop areas of Bommer Member of the Topanga Formation (Conkling et al., 1997).

Los Trancos Member of the Topanga Formation. This member contains abundant fossils, including bivalves, gastropods, echinoderms, crabs, palm and leaf impressions, algae impressions, wood, fish bones and scales, shark teeth and bones, ray plates, and turtle bones, many of which were collected during grading for SR-73 (JMA, 1995 and Conkling et al., 1997) and adjacent to SR-73 at the Coyote Canyon Landfill (Conkling and Smith, 1995).

Monterey Formation. Several significant invertebrate and vertebrate localities are recorded from the south County area. These include: fossils of crocodilians, fish, shark, ray, whale, dolphin, sea lion, sea cow, desmostylan, bivalves, gastropods, barnacles, bryozoan, and sand dollars. Morton et al. (1974) state that the upper part of this formation contains Late Miocene forms (Luisian and Mohinian), and the lower section contains sandstones with megafossils that suggest slightly older stages (*Pecten crassicardio* and *Vaquerosella* cf. *merriama*). Eisentraut and Cooper (2002) report that numerous fossil fish and marine mammal remains have been recovered from this formation on the Irvine coast and in the Laguna Hills area. They also state that a localized limestone deposit in the Aliso Viejo area known as "Pecten Reef" has produced abundant invertebrate and vertebrate fossils.

Capistrano Formation. Late Miocene to Early Pliocene (Upper Mohnian, Delmontian, and Repettian) foraminifera have been identified in this member (Smith, 1960). Recent work by John Minch and Associates has identified plants, fish *(Clupeidae* and *Sciaenidae),* aves (cf. *Mancala* sp.), *Desmatophocidae,* pinnipeds *(Otaridae* and *Phocidae), Delphinidae*, and *Mysticeti* from this formation, many from the SR-73 alignment (JMA, 1995). An almost complete *Mysticeti* was found and collected at the Greenfield exit on northbound SR-73. LSA and Pertra Resources, Inc. recovered whales, sharks, and terrestrial and marine plants in the Prima Deshecha Landfill in San Juan Capistrano. Eisentraut and Cooper (2002) report that the siltstone member of this formation produced abundant and diverse marine vertebrates, including fish, shark, whale, dolphin, porpoise, sea lion, sea cow, and seagoing birds. They also report that the Marblehead project near San Clemente yielded voluminous and exceptional fauna.

Marine Terrace Deposits. Fossils have been recovered from these sediments at the corner of Pacific Coast Highway and MacArthur Boulevard (LACM 4254) and throughout the Newport Back Bay area (including the Newport Mesa localities [Miller, 1971]). These Marine Terrace Deposit localities contain invertebrate and vertebrate fossils such as bivalves, gastropods, echinoderms, shark, fish, seal, whale, horse, camel, bison, and elephant.

Older Alluvium. Fossils have been collected in similar deposits from excavations for roads, housing developments, retention basins, and quarries in the Los Angeles Basin and vicinity (Lander, 2003; Jefferson, 1991a and 1991b; Conkling, 1997 and 1988; Miller, 1971). Remains of Rancholabrean animals, including elephant, horse, bison, camel, saber tooth cat, deer, and sloth, are known from these localities. The potential exists to encounter similar fossils in all Pleistocene alluvium.

Landslide Deposits. There is a low potential for fossils within these sediments. Usually, any fossils within these sediments are derived from the older formations from which the slide originated; however, there is a slight possibility that fossils of organisms caught within the slide material may be present. Unless it can be determined that the landslide is shallow and the underlying bedrock will be exposed, these sediments are considered to have a low paleontological sensitivity.

Young Alluvium. Young alluvium can contain remains of once-living things such as bones, shells, and plants; however, as these are less than 10,000 years old, not enough time has passed to mineralize the remains, and they are not considered to be "fossils." In addition, most of the remains that are found are contemporaneous with modern species. Occasionally, fossils from older upstream formations are eroded out and transported to a new location. However, it is usually impossible to determine where the fossils originally came from.

Artificial Fill. Artificial fill can contain fossils, but these fossils have been removed from their original location and are thus out of context. They are not considered to be important for scientific study.

Museum Records

The LACM does not have any recorded vertebrate localities within any of the proposed basins nor along the entire length of SR-73. However, the LACM does have several localities near SR-73 from the same or similar sedimentary deposits that occur within the project area.

Sespe Formation. The closest vertebrate fossil localities from the Sespe Formation are LACM 5448, 6935, 6938, 6940-6945, and 7326–7328, all within the Santa Ana Mountains. Locality LACM 5448 is situated 7.5 miles to the northeast of the eastern portion of the proposed project route area, just above Borrego Canyon Wash and east of the former El Toro Marine Corps Air Station, and the other localities occur around Bee Canyon, northeast of the former El Toro Marine Corps Air Station, approximately 9 miles to the northeast. These localities have produced a suite of terrestrial fossil vertebrates, including alligator lizard (*Gerrhonotus)*, iguana (*Parasauromalus)*, opossum, (*Nanodelphys)*, oreodonts (*Merychyus*, *Oreodontoides*, and *Sespia)*, dogs (*Mesocyon* and *Vulpes)*, pika (*Cuyamalagus)*, wood rat, (*Leidymys)*, pocket gopher (*Schizodontomys)*, pocket mice (*Mookomys*, *Perognathus*, and *Proheteromys)*, and squirrels (*Miospermophilus*, *Nototamias*, and *Protosciurus*).

Vaqueros Formation. The closest vertebrate fossil localities from the Vaqueros Formation are LACM 7505, 7548-7553, 7675-7678, and 7712, all situated northeast of the central portion of the proposed project route area in the San Joaquin Hills, immediately south of the San Diego Freeway and west of the Laguna Reservoir, approximately three miles to the north. These localities have produced highly significant vertebrate fossils, including specimens of eagle ray (*Myliobatis*), requiem sharks (*Carcharinidae*), basking shark (*Cetorhinus*), extinct four-legged marine mammals (*Desmostylia*), extinct toothed whales (*Argyrocetus*, *Platanistidae*, and *Squalodontidae*), and extinct baleen whales (*Eomysticetidae* and *Cetotheriidae*).

Topanga Formation. Most of the closest vertebrate fossil localities from the Topanga Formation are south to southwest of the eastern portion of the proposed project route area. These localities include LACM 3222, on the west side of Aliso Creek Canyon, approximately due east of the intersection of the Pacific Coast Highway, and Bluebird Canyon Drive in Laguna Beach, approximately 3.6 miles to the southwest, which produced a fossil specimen of the rare and peculiar four-legged marine mammal *Desmostylia* (*Desmostylus* sp.). Locality LACM 7249, on top of the ridge north of Temple Hill in Laguna Beach, approximately 1.8 miles to the south, produced a fossil specimen of the sea cow *Dioplotherium allisoni*. LACM 4007, in Rim Rock Canyon west of Temple Hill, approximately 3.2 miles to the south, produced a fossil specimen of sea cow *Dugongidae*. Northeast of the eastern portion of the proposed project route area, LACM 6064, east of Marguerite Parkway, between La Paz Road and Oso Parkway in Mission Viejo, approximately 2.8 miles to the northeast, produced a nearly complete skeleton of another desmostylian, *Paleoparadoxia*.

Monterey Formation. The closest LACM vertebrate fossil localities from the Monterey Formation on the western end of SR-73 are located approximately two miles southwest of the western portion of the proposed project route area in the bluffs along Backbay Drive, west of Jamboree Road and south of San Joaquin Hills Road. LACM 1160 and 7139 produced undetermined fossils of bony fish (*Osteichthyes*), and baleen whale (*Mysticeti*).

In the eastern portion of the proposed project route area, the closest LACM vertebrate fossil localities from the Monterey Formation to the north are LACM 3863, 4919, 5143-5145, and 5786, situated roughly between Aliso Creek and La Paz Road, approximately 0.8 mile to the northeast, that produced fossil specimens of herring (*Ganolytes cameo)*, snake mackerel (*Thyrsocles kriegeri*), sculpin (*Cottidae*), walrus (*Imagotaria)*, extinct baleen whale (*Herpetocetus*), and sperm whale (*Scaldicetus)*.

In the eastern portion of the proposed project route area, the closest LACM vertebrate fossil localities from the Monterey Formation to the south are LACM 7305 and 7431, around Heather Ridge south of Pacific Park Drive, 0.5 mile to the southwest; and LACM 1101, 3185, 3541, south of Pacific Park Drive and west of Aliso Creek Road, 0.7 mile to the southwest. These localities produced a composite fossil fauna including bonito shark (*Isurus hastalis)*, eagle ray (*Myliobatidae*), scad (*Decapterus*), snake mackerel (*Thyrsocles kriegeri*), mackerel (*Scombridae*), leatherback turtle (*Psephophorus)*, murrelet (*Praemancalla wetmorei)*, booby (*Morus lompocanus)*, shearwater (*Puffinus barnesi*), sea lion (*Allodesmus kernensis*), dolphin (*Pithanodelphis nasalis)*, baleen whale (*Mixocetus*), dugong (*Dusisiren jordani)*, a fossil sea lion (*Allodesmus kernensis*), and several fossil birds.

Numerous vertebrate fossil localities from the Monterey Formation slightly farther south of this portion of the proposed project route area, in the general area of the ridge where the Chet Holifield Federal Building was constructed, from Alicia Parkway to just east to La Paz Road and from just north of Avila Road to just south of Aliso Creek Road, approximately one mile to the southwest. Several of these sites have produced spectacular vertebrate fossil specimens as well as the holotypes of new species of fossil vertebrates. A considerable number of these Monterey Formation localities, LACM 5065–5083 and 6901–6906, were discovered during excavations for what is now the Chet Holifield Federal Building. H. Howard named four new species of fossil sea birds from these localities: loon (*Gavia brodkorbi)*, booby, flightless auk (*Preamancalla wetmorei*), and fossil shearwater (*Puffinus barnesi)*. Other vertebrates include: extinct dolphin (*Pithanodelphis nasalis)*, sea turtle (*Chelonia)*, a dugong, and a sea lion (*Imagotaria)*. Uncommon or rare taxa from these localities include a chimaera (*Hydrolagus colliei)*, sabretooth salmon (*Smilodonichthyes rastrosus)*, false-toothed bird (*Osteodontornis orri*), the extinct quadrupedal marine mammal *Desmostylus*, beluga whale (*Monodontidae*), and beaked whale (*Ziphiidae*).

Capistrano Formation. The closest LACM vertebrate localities in the Capistrano Formation are LACM 4630 and 5465, south of the eastern portion of the proposed project route area, north of Avila Road, between La Paz Road and Moulton Parkway, approximately 0.4 mile to the southwest; and LACM 3184 and 3867, just south of the eastern terminus of the proposed project route area, north of Crown Valley Parkway, less than 1 mile to the southwest. These localities produced a small composite fauna, including chimaera (*Chimaeridae*), requiem sharks (*Carchrinidae*), dogfish (*Sqaulidae*), undetermined bony fish (*Teleostei*), puffin (*Alcidae*), porpoise (*Phocoenidae*), and blue whale (*Balaenoptera musculus)*.

Older Nonmarine Terrace Deposits. In the northwestern portion of the project area, LACM 1068-1069 and 1086, located south of University Drive and east of MacArthur Boulevard, and LACM 1066, 1240, 3407, 3877, 4426, and 6736, located between MacArthur Boulevard west to Eastbluff Drive and south to Ford Road, all produced a rich suite of Pleistocene vertebrates. In the eastern portion of the proposed project area, between La Paz Road and Moulton Parkway, just to the north of SR-73, LACM localities LACM 4628 and 4629 produced fossil specimens of mammoth (*Mammuthus* sp.), bison (*Bison* sp.), horse (*Equus* sp.), and a tapir (*Tapirus californicus*).

The LACM believes that shallow excavations in the uppermost few feet of the younger Quaternary alluvium exposed in all of the drainages and other less elevated portions of the proposed project route are not likely to uncover significant fossil vertebrate remains. Deeper excavations in the areas mapped as Quaternary alluvium that extend down toward older sedimentary deposits, however, may well encounter significant vertebrate fossils. Any excavations in the older Quaternary Terrace deposits, the Capistrano Formation, the Monterey Formation, the Topanga Formation, the Vaqueros Formation, or the Sespe Formation are quite likely to encounter significant to highly significant vertebrate fossils. Therefore the LACM believes that except for recent Quaternary alluvium, the paleontological sensitivity of the proposed project route area is rated high. The LACM believes that any substantial excavations in the basins should be closely monitored to quickly and professionally collect any specimens without impeding development. Any fossils recovered during mitigation should be deposited in an accredited and permanent scientific institution for the benefit of current and future generations. A copy of the LACM letter is attached in Appendix C and includes a list of species collected from nearby LACM localities.

The specific sensitivities for formations and units within the study area are listed in Table C. This lists the sensitivities determined by Eisentraut and Cooper (2002) and the corresponding Paleontological Potential Scale used by the Department. Sensitivities (and potential) for the older alluvium, the Marine Terrace deposits, the Capistrano Formation, the Monterey Formation, the Topanga Formation,

Table C: Paleontological Sensitivity of the Geologic Units within the Study Area

Geologic Unit	Paleontological Sensitivity (Eisentraut and Cooper, 2002)	Paleontological Potential (the Department)
Artificial Fill	Not Rated	Low
Young Alluvium	None	Low
Landslide Deposits	Not Rated	Low
Older Alluvium	High	High
Marine Terrace Deposits	High	High
Capistrano Formation	Very High	High
Monterey Formation	Very High	High
Topanga Formation (all members)	Very High	High
Sespe Formation	Very High	High

and the Sespe Formation are all high to very high, based on the presence of significant fossil remains that have been recovered from these units in other areas. It is likely that similar significant resources may be encountered if these units are encountered during excavation associated with the SR-73 Basins. Artificial fill is not rated by Eisentraut and Cooper (2002); however, unless depth is known, it is usually assigned a sensitivity of "low" in the event that excavation extends below the fill to the underlying formation or unit. The young alluvium has no sensitivity according to Eisentraut and Cooper (2002), as it is too young to contain paleontological resources; however, like the artificial fill, it is usually assigned a sensitivity of "low" as well in case it is shallow and the underlying sediments are encountered. The landslide deposits have transported any fossils within the landslide block out of context, thus rendering them not significant and resulting in a low sensitivity rating.

FIELD SURVEY

The pedestrian survey confirmed much of the geology, as it has been mapped, but also identified a number of basins that contain artificial fill. The only observed fossils were located within Basins 1032R and 1032L, where fossil plant material was observed in the exposed bedrock. The observed geology at each basin that has proposed excavation is presented in Table D.

Based on the observed bedrock, or sediment within each basin where excavation is proposed, the sensitivity was determined based on using the rating system by Eisentraut and Cooper (2002). For basins that have no proposed excavation, no further mitigation is required unless plans change to include grading.

Table D: Observed Geology at Each Basin that Has Proposed Excavation

Basin Name	UTM NAD83 Zone 11		Proposed Work within Basin	Geology as Mapped	Geology Observed	Paleontological Sensitivity (Based on Field Observations)
	Easting	Northing				
457L	437331	3712040	A concrete v-ditch with riprap dissipation will be constructed to divert water runoff to the basin and prevent sedimentation from running off onto private access road or concrete channel	Recent Alluvium and landslide in Capistrano	Fill and alluvium	Low
506R[1]	436704	3713353	A concrete v-ditch will be constructed at the toe of the perimeter slope	Capistrano	Fill in Basin, Capistrano Formation on slopes	Low to Very High
535L	435809	3713494	Construct a concrete base around the drain outlet.	Capistrano	Fill in Basin, Capistrano Formation at outlet	Very High
583L	434922	3714540	Perform minor slope grading to reduce puddles and nuisance water.	Recent Alluvium and maybe Capistrano	Capistrano Formation on slopes, basin floor obscured with water and cattails	Very High
604R	434549	3715153	Perform minor grading to restore gravel access road	Recent Alluvium and Capistrano	Fill and alluvium, no bedrock observed	Low
613L	434260	3715129	Extend and restore existing access road with gravel. Add paving to the gore area at La Paz Road	Capistrano	Fill	Low
630L	433896	3715312	No excavation in basin	Recent Alluviun	Not surveyed	-
635L	433611	3715435	Install a gravel access road	Monterey and Recent Alluvium	Appears to be fill	Low
654R	433219	3715901	No excavation in basin	Monterey	Not surveyed	-
659L	432965	3715842	No excavation in basin	Recent Alluvium	Not surveyed	-
696R	432083	3716705	No excavation in basin	Monterey	Not surveyed	-
765L	430061	3716962	No excavation in basin	Recent Alluvium	Not surveyed	-
757L	430323	3716972	No excavation in basin	Recent Alluvium	Not surveyed	-

Table D: Observed Geology at Each Basin that Has Proposed Excavation

Basin Name	UTM NAD83 Zone 11		Proposed Work within Basin	Geology as Mapped	Geology Observed	Paleontological Sensitivity (Based on Field Observations)
	Easting	Northing				
780R[2]	429631	3717252	Repair slope and add catchment wall along the northbound Laguna Canyon Road exit (0.5 acre of impact in coastal sage scrub vegetation area) Add retaining wall at toe of excavated slope.	Sespe and Recent Alluvium	Sespe Formation	Very High
785L	429486	3717033	Construct paving and gravel access	Recent Alluvium	Alluvium	Low
789L	429358	3717234	Appears to be no excavation	Qls in Topanga – Undifferentiated	Overgrown, no surface visibility	Low
808R	429076	3717649	No excavation in basin	Sespe and Recent Alluvium (may be fill)	Not surveyed	-
859L	427531	3718149	No excavation in basin	Topanga – Bommer	Not surveyed	-
878R[3]	427014	3718437	Add v-ditches at the north side of the basin slope to carry storm water in the basin.	Topanga – Bommer	Bommer Member of the Topanga	Very High
883L	426849	3718306	No excavation in basin	Topanga – Bommer	Not surveyed	-
893L	426549	3718388	No excavation in basin	Topanga –Bommer	Not surveyed	-
922R	425870	3718943	Regrade, clean riprap, and add fiber rolls at drain inlet (S33 and S32). Repair and stabilize slope and drainage ditches below both sides of wildlife crossing.	Topanga – Bommer	Fill	Low
930L[4]	425522	3718896	No excavation in basin	Topanga – Bommer	Overgrown, no surface visibility	Very High
1032R[5]	423236	3720785	Install catchments wall at the toe of the slope of the loop on-ramp	Topanga – Los Trancos	Los Trancos Member of the Topanga. Plant fossils observed	Very High

Table D: Observed Geology at Each Basin that Has Proposed Excavation

Basin Name	UTM NAD83 Zone 11		Proposed Work within Basin	Geology as Mapped	Geology Observed	Paleontological Sensitivity (Based on Field Observations)
	Easting	Northing				
1032L[6]	423165	3720614	Improve the basin slope with minor grading	Topanga – Los Trancos	Los Trancos Member of the Topanga. Plant fossils observed	Very High
1075L	422213	3721373	Minor slope repair in the basin	Nonmarine Terrace and Alluvium	Fill	Low
1076R	422133	3721534	Replenish access road with gravel and construct a concrete paving apron	Nonmarine Terrace and Alluvium	Alluvium	Low
1080R	422039	3721602	No excavation in basin	Recent Alluvium and Fill	Not surveyed	-
1081L	422001	3721458	Replenish access road with gravel and construct a concrete paving apron	Nonmarine Terrace and Alluvium	Fill	Low
1085L	421874	3721505	No excavation in basin	Nonmarine Terrace and Alluvium	Not surveyed	-
1133L	420595	3722231	Proposing to improve the basin slope with minor grading	Recent Alluvium	Fill and alluvium	Low
1137L	420482	3722334	No excavation in basin	Recent Alluvium	Not surveyed	Low
1143L	420369	3722514	No excavation in basin	Recent Alluvium	Not surveyed	Low
1149L	420125	3722604	No excavation in basin	Marine Terrace over Niguel	Not surveyed	-
1151L	420265	3722668	Propose minor grading to prevent further standing water within the basin Clean up and regravel the access road	Recent Alluvium	Fill	Low
1156R[7]	420331	3722863	Propose minor grading to prevent further standing water within the basin Clean up and regravel the access road to the adjacent basin 1148R	Recent Alluvium and Marine Terrace	Alluvium	High Marine terrace deposits may exist below the alluvium.

Table D: Observed Geology at Each Basin that Has Proposed Excavation

Basin Name	UTM NAD83 Zone 11		Proposed Work within Basin	Geology as Mapped	Geology Observed	Paleontological Sensitivity (Based on Field Observations)
	Easting	Northing				
			Redesign a section of the existing concrete v-ditch to resolve standing water issue			
1180R	420232	3723618	Provide catchment wall along access road where steep cut creates erosion	Recent Alluvium, maybe Qtm	Alluvium on access road, concrete obscures basin bottom	Low
1183L	420053	3723730	No excavation in basin	Recent Alluvium	Not surveyed	Low
1194R	420091	3724046	No excavation in basin	Fill over Recent Alluvium	Not surveyed	Low

Source: LSA Associates, Inc.

1 Located near Greenfield Quarry with whales (JMA, 1995).
2 Located near terrestrial mammal localities collected by LSA (Conkling et al., 1997).
3 Located near invertebrate localities collected by LSA (Conkling et al., 1997).
4 Ibid.
5 Located near plant localities collected by JMA (JMA, 1995).
6 Ibid.
7 Located near invertebrate and vertebrate localities collected by JMA (JMA, 1996).

RECOMMENDATIONS FOR THE PMP

INTRODUCTION

The Department, the County, and the SVP all present similar guidelines for adequate mitigation of impacts to significant nonrenewable paleontological resources. Excerpts from individual guidelines follow.

ORANGE COUNTY

As far back as the 1970s, the County recognized the need to try to preserve the its fossil heritage. The County developed a set of guidelines (Resolution 77-866) that stated that developers on projects that involved earthwork were required to hire a professional paleontologist to:

- Conduct literature and records research prior to the start of grading to determine whether fossils might be encountered during construction;
- Conduct surveys prior to the beginning of grading to determine the significance and extent of fossils of fossil-bearing sediments within the project;
- Provide trained paleontological monitors to collect fossil remains during grading; and
- Preserve any collected fossils by maintaining them in an undisturbed condition, or excavating and salvaging in a scientific manner and keeping the fossils readily accessible for future study, if possible.

These guidelines were further refined by Eisentraut and Cooper (2002) during their preparation of a model curation program for Orange County. This program conforms to the recommendations of the SVP guidelines and is similar to those provided by the Department to reduce construction-related impacts to significant nonrenewable paleontological resources. After the potential for paleontological resources has been determined by a records search and field inspection, the following steps are recommended to occur with construction excavation:

- **Monitoring of excavation operations** to discover unearthed fossil remains, generally involving close inspection/surveillance of ongoing excavation exposures. Monitoring time will be in accordance with the paleontological sensitivity rating (see previous discussion of paleontological sensitivity scale) for the particular stratigraphic unit being excavated. Routinely, very-high-sensitivity units will require full-time monitoring; high-sensitivity units will require a minimum of three-quarter-time monitoring; moderate-sensitivity units will require at least half-time monitoring; low-sensitivity units will require one-quarter-time monitoring; no-sensitivity units will require no monitoring. Monitoring time can be increased or decreased over time depending on what is being discovered or not discovered.

- **Salvage of unearthed fossil remains**, typically involving simple excavation of the flagged-off exposed specimen but possibly also plaster-jacketing of large and/or fragile specimens or concentrations of fossils, or more elaborate quarry excavations of richly fossiliferous deposits; decisions about what is collected will be based on in-field assessment of determined or potential paleontological significance.
- **Recovery of stratigraphic and geologic data** to provide a context for the recovered fossil remains, typically including legible, well-organized field note descriptions of lithologies of fossil-bearing strata, and measurement and description of the overall stratigraphic section if possible.
- **Careful recording of specimen localities** on maps, including site or grading maps, and, most importantly, on standard, most up-to-date USGS 7.5-minute (1:24,000) quadrangle sheets; accurate longitude-latitude and Universal Transverse Mercator (UTM) coordinates should be given for each locality, and global positioning system (GPS) technology should be employed whenever possible. Additional information, such as formation name, sediment description, elevation, field identification, location within the stratigraphic section (if possible), and a general to specific description of the fossil location, should also be recorded.
- **Laboratory preparation** to the point of taxonomic identification. This generally involves removal of the enclosing sediment; stabilization of fragile specimens using glue and other hardeners; and repair of broken specimens. In addition, bulk material should be screen-washed to recover small specimens, such as vertebrate bones and teeth, that are difficult to see because of their small size.
- **Cataloguing and identification** of prepared fossil remains to the lowest taxonomic level feasible. Taxonomic experts should be consulted to assist with the identification and ensure that identification is accurate and note whether the specimen is new and/or unique to the formation or region.
- **Transferal, for accessioning for storage**, of catalogued fossil remains, including the specimens themselves, copies of all field notes, maps (with locality information accurately posted), stratigraphic sections, and any photographs.
- **Preparation and submittal of a final report** summarizing the project area investigated, the field and laboratory methods used, the stratigraphic units inspected, the types of fossils recovered, the scientific significance of the curated collection, and recommendation for further work, if needed.

SOCIETY OF VERTEBRATE PALEONTOLOGY

Recommended general guidelines for conformable impact mitigation to significant nonrenewable paleontological resources have been published by the SVP (1995) along with conditions of receivership that the repository institution can require when receiving fossils recovered from construction projects (SVP, 1996). In areas determined through a records check and field survey to have a high potential for significant paleontological resources, an adequate program for mitigating the impact of development should include:

- A preliminary survey and surface salvage of any observed fossils prior to construction;
- Monitoring and salvage during project excavation;

- Preparation, including screen washing to recover small specimens (if applicable) and specimen preparation to a point of stabilization and identification;
- Identification, cataloging, curation, and storage into a museum or university that has a curator who can retrieve the specimens upon request; and
- A final report of the finds and their significance after all operations are completed.

All phases of mitigation are to be supervised by a professional paleontologist who maintains the necessary paleontological collecting permits and repository agreements. The Lead Agency ensures compliance with the measures developed to mitigate impacts of excavation during the initial assessment. To ensure compliance from the start of the project, a statement that confirms the site's potential sensitivity, confirms the repository agreement with an established institution, and indicates the program for impact mitigation should be deposited with the Lead Agency and contractors before work begins. The program will be reviewed and accepted by the Lead Agency's designated vertebrate paleontologist. If a mitigation program is initiated early during the course of project planning, construction delays due to paleontologic salvage activities can be minimized or avoided.

CALIFORNIA DEPARTMENT OF TRANSPORTATION

The Department has developed a set of guidelines similar those of the SVP to reduce impacts to paleontological resources. These recommendations start with avoidance of the resource area by the project and continue with recommendations for impact mitigation measures during construction excavation.

Avoidance

Avoidance of project impacts can be achieved by project redesign so that paleontological resources are completely outside the project's impact area (e.g., a different alignment route that misses the resource or a construction approach that does not entail construction excavation that would impact fossiliferous strata).

Environmentally Sensitive Areas

A related strategy creates Environmentally Sensitive Areas (ESAs) around paleontological localities. ESAs are a standard part of the Department and FHWA toolkit to protect resources within or immediately adjacent to a project while concurrently delivering the project. Generally, these involve some combination of fencing or cyclic monitoring as an alternative to excavation monitoring. In the event that the special measures prove ineffective for one reason or another, more traditional mitigation is necessarily called for. This fallback sometimes impacts delivery schedules and/or total project costs. If viable and properly implemented, however, ESAs can reduce costs and time associated with more extensive traditional mitigation approaches.

The Department's PMP

Since the geology of California is diverse and the nature of the fossils that it contains varies from one outcrop to the next, the Department does not provide generic paleontological resource impact mitigation, but instead presents a format for the PMP that can be utilized by the professional project paleontologist who has been retained to manage paleontological resources during project development. A full list of sections of the PMP is included in the Department's SER Environmental Handbook, Volume 1, Chapter 8. Briefly, the PMP sections are:

- **Introduction.** A brief discussion of the goals of the proposed study, a discussion of the construction project effects, and why mitigation is needed (e.g., compliance with CEQA).
- **Background.** Pertinent information should be provided in order to demonstrate familiarity with the project area and the type of fossils and rock units under study.
- **Description of the Resource.** A description of the rock units, boundaries of the fossiliferous formations, and locations of exposures in the vicinity of the project area and in the ADI.
- **Proposed Research.** A clear, concise description of why the paleontological resource is significant or has scientific importance, and how the study is expected to address current gaps in the paleontological data.
- **Scope of Work.** The work plan to mitigate project effects, including all fieldwork and laboratory efforts. This may include:
    - Procedures for interfacing paleontological and construction personnel developed in consultation with the Resident Engineer (RE).
    - Construction monitoring programs should be outlined.
    - Salvage methods should be outlined from large specimen recovery to collection and processing of microfossils.
    - Recovered specimens should be prepared to a point of identification and stabilized for preservation in conformance with individual repository requirements.
    - All recovered specimens should be cataloged using the format of the proposed curation facility.
    - Not all located fossils need to be recovered. Criteria for the discarding of specific fossil specimens should be made explicit.
- **Decision Thresholds.** How and when fieldwork will achieve the study goals, allowing fieldwork to cease; or, any circumstances under which additional effort might be needed to achieve study goals.
- **Schedule.** The schedule for completing the proposed work may appear as text or in graphic form (e.g., a timeline) and include a start date, duration of fieldwork and laboratory processing, and time for report preparation.
- **Justification of Cost Estimate.** Provides narrative support for the cost estimate, including the basis for person-hour estimates, clarification of overhead percentages, and any other costs.

- **Cost Estimate.** Presented as an appendix, this documentation should present a tabular summary of costs for the proposed effort and include all proposed numbers and levels of personnel, time, and costs.
- **Bibliography.** The bibliography should include only those references cited in the plan.
- **Curation.** The curation facility should be identified and a draft curation agreement included. A curation agreement with an approved facility must be in place prior to initiating any paleontological monitoring or mitigation activities.

The plan should be prepared by or under the supervision of a qualified Principal Paleontologist and submitted for review sufficiently in advance of an anticipated start work date so that all involved agencies have time to comment, the Lead Agency has time to adjust the plan to accommodate such input, and the plan may be resubmitted for all necessary approvals. In the case of Department projects, coordination with other agencies should be accomplished through Department staff rather than consultants directly approaching land managing/regulatory agencies. It is imperative that all agencies with jurisdiction over a paleontological site are in agreement as to the level of effort in the mitigation plan, including agreement on the applicability of pertinent laws, regulations, and permit requirements. When properly designed, the PMP serves as a basis for obtaining any necessary permits from other agencies.

Specific interagency issues may include, but are not limited to, health and safety issues, employee access and egress, collection, removal and stockpiling of fossiliferous sediment, water washing, wet screen processing of fossiliferous sediment and disposal of muddy wastewater, and use of chemicals (kerosene) to break down specific types of indurated fossiliferous sediment. Agency permits that may be needed for access or to conduct the work of monitoring and salvage should be applied for and obtained in advance of the project.

SUMMARY

The SR-73 Basin Project in the San Joaquin Hills of Orange County crosses four fossiliferous Tertiary formations deposited during the last 19 million years to 1.8 million years and two fossiliferous early to late Pleistocene sediments deposited during the last 1.8 million years. These fossiliferous sediments crop out at the surface and may also be encountered below the surface of the proposed project. This study presents definitions of paleontological significance and sensitivity, the results of records search requests, and reviews of geological and paleontological literature. Table D contains a summary of proposed work within each basin, the mapped and observed geology, and the paleontological sensitivity for those basins that will involve excavation. Twenty-five of the 39 basins will involve ground-disturbing activities, but only 8 of these will be in sensitive sediments. The basins that will involve excavation in sensitive sediments include: 506R; 535L; 583I; 780R; 878R; 1032R; 1032L; and 1156R. Although the geology observed at Basin 1156R was alluvium, geologic mapping by Morton and Miller (2006) indicates that Marine Terrace deposits, which have a high paleontological sensitivity, may exist here below the alluvium, and may be encountered during excavation. In addition, JMA (1996) collected numerous fossils from the Marine Terrace deposits in the immediate area. As such, 1156R will also require mitigation. Basins that have no excavation, or that have been identified as having sediments with a low sensitivity, will not require any mitigation.

This study does not anticipate special paleontological situations that would require project redesign to avoid critical localities or strata. Consequently, a paleontological resources impact mitigation program is recommended prior to completion of final design within those areas of the project identified as having high sensitivity. This PMP should be synthesized from outlines and guidelines provided by the Department, the County of Orange, and the SVP, and specifically tailored to the resources and sedimentary formations that will be encountered during excavation within the SR-73 Basins located within sediments that have the potential to contain paleontological remains. It is recommended that the PMP be written in the early planning stages of reports for the SR-73 Basins, documenting and describing impact mitigation programs that must accompany project final design and development.

This study recommends that the section of the PMP describing the excavation monitoring for the project include the following:

- A preconstruction field survey should be conducted in areas identified as having a high paleontological sensitivity after vegetation and any paving is removed, followed by salvaging of any observed surface paleontological resources prior to the beginning of additional ground-disturbing activities.
- Attendance at the pregrade meeting by a qualified paleontologist or his/her representative. At this meeting, the paleontologist will explain the likelihood for encountering paleontological resources, what resources may be discovered, and the methods that will be employed if anything is discovered (see below).

- During construction excavation, a qualified vertebrate paleontologic monitor shall initially be present on a full-time basis whenever excavation will occur within the sediments that have a high paleontological sensitivity rating and on a spot-check basis for sediments that have a low sensitivity rating. Monitoring may be reduced to a part-time basis if no resources are being discovered in sediments with a high sensitivity rating (monitoring reductions and when they occur will be determined by the qualified Principal Paleontologist). The monitor shall inspect fresh cuts and/or spoils piles to recover paleontological resources. The monitor shall be empowered to temporarily divert construction equipment away from the immediate area of the discovery. The monitor shall be equipped to rapidly stabilize and remove fossils to avoid prolonged delays to construction schedules. If large mammal fossils or large concentrations of fossils are encountered, the Department shall consider using heavy equipment on site to assist in the removal and collection of large materials.
- Localized concentrations of small (or micro-) vertebrates may be found in all native sediments. Therefore, it is recommended that these native sediments occasionally be spot-screened on site through one-eighth to one-twentieth-inch mesh screens to determine whether microfossils are present. If microfossils are encountered, sediment samples (up to 3 cubic yards, or 6,000 pounds) shall be collected and processed through one-twentieth-inch mesh screens to recover additional fossils.
- Any recovered specimens shall be prepared to the point of identification and permanent preservation. This includes the sorting of any washed mass samples to recover small invertebrate and vertebrate fossils, the removal of surplus sediment from around larger specimens to reduce the volume of storage for the repository and storage cost, and the addition of approved chemical hardeners/stabilizers to fragile specimens.
- Specimens shall be identified to the lowest taxonomic level possible and curated into an institutional repository with retrievable storage. The repository institutions usually charge a one-time fee based on volume, so removing surplus sediment is important. The repository institution may be a local museum or university that has a curator who can retrieve the specimens on request. The Department requires that a draft curation agreement be in place with an approved curation facility prior to the initiation of any paleontological monitoring or mitigation activities.

By following the above guidelines, impacts to nonrenewable paleontological resources will be maintained below a level of significance. During the development of the PMP, additional measures may be added; this list is only meant to provide a summary of what may be involved.

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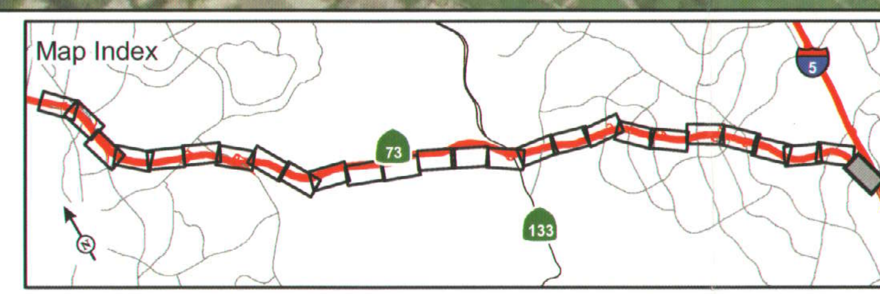
APPENDIX A

SR-73 BASIN SEDIMENTATION PROJECT APE MAP

Caltrans District 12 Local Assistance Engineer	Date
Caltrans District 12 - Archeologist (PQS)	Date



Area of Potential Effects
Planting W/Irrigation
Gravel Access Road
Rip Rap Dissipation
Concrete V-Ditches
Asphalt Concrete Curb
Chainlink Fence
Concrete Catchment Wall
Grading Work W/Topsoil
Paving (Concrete Asphalt, Concrete)

NOTE: Basin I.D. # - e.g., 457L

0 100 200 Feet

SOURCE: DigitalGlobe (4/08)

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APPENDIX A

Sheet 1 of 26

SR-73 Basin Sedimentation Project

Area of Potential Effects

EA# 0H4400

12-ORA-73 PM 10/24.5

Area of Potential Effects
Planting W/Irrigation
Gravel Access Road
Rip Rap Dissipation
Concrete V-Ditches
Asphalt Concrete Curb
Chainlink Fence
Concrete Catchment Wall
Grading Work W/Topsoil
Paving (Concrete Asphalt, Concrete)

NOTE: Basin I.D. # - e.g., 457L

0 100 200 Feet

SOURCE: DigitalGlobe (4/08)

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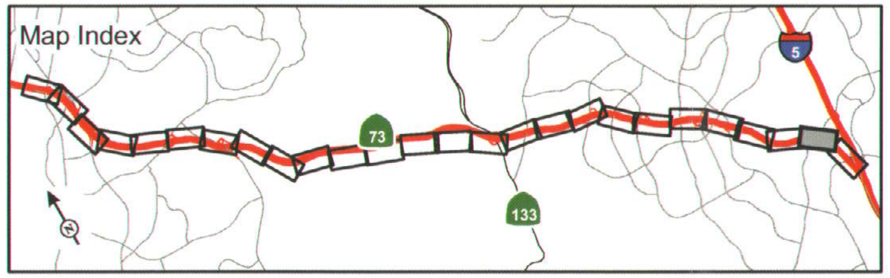


APPENDIX A

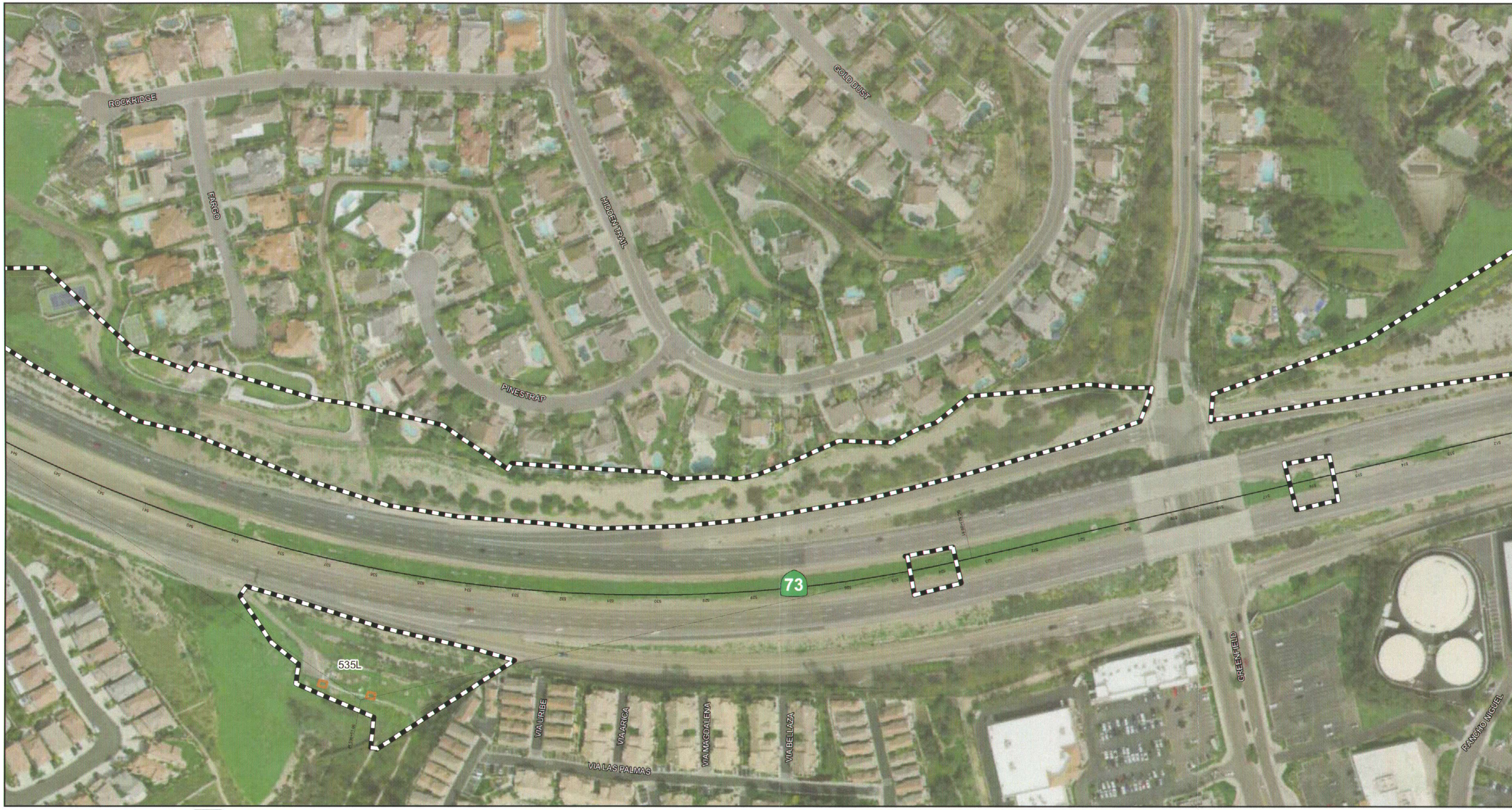
Sheet 2 of 26

SR-73 Basin Sedimentation Project

Area of Potential Effects

EA# 0H4400

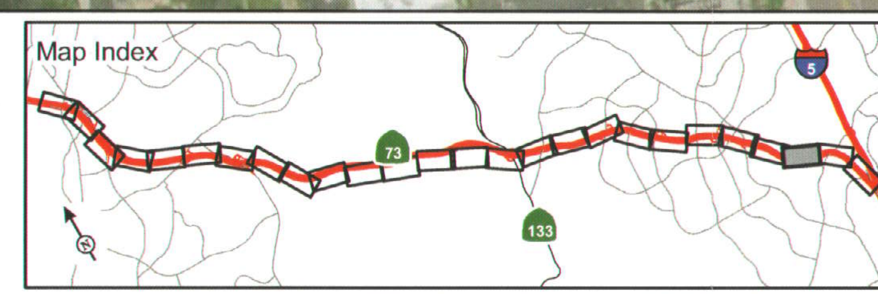
12-ORA-73 PM 10/24.5



Area of Potential Effects
Planting W/Irrigation
Gravel Access Road
Rip Rap Dissipation
Concrete V-Ditches
Asphalt Concrete Curb
Chainlink Fence
Concrete Catchment Wall
Grading Work W/Topsoil
Paving (Concrete Asphalt, Concrete)

0 100 200 Feet

NOTE: Basin I.D. # - e.g., 457L



APPENDIX A
Sheet 3 of 26

SR-73 Basin Sedimentation Project

Area of Potential Effects

EA# 0H4400
12-ORA-73 PM 10/24.5

SOURCE: DigitalGlobe (4/08)
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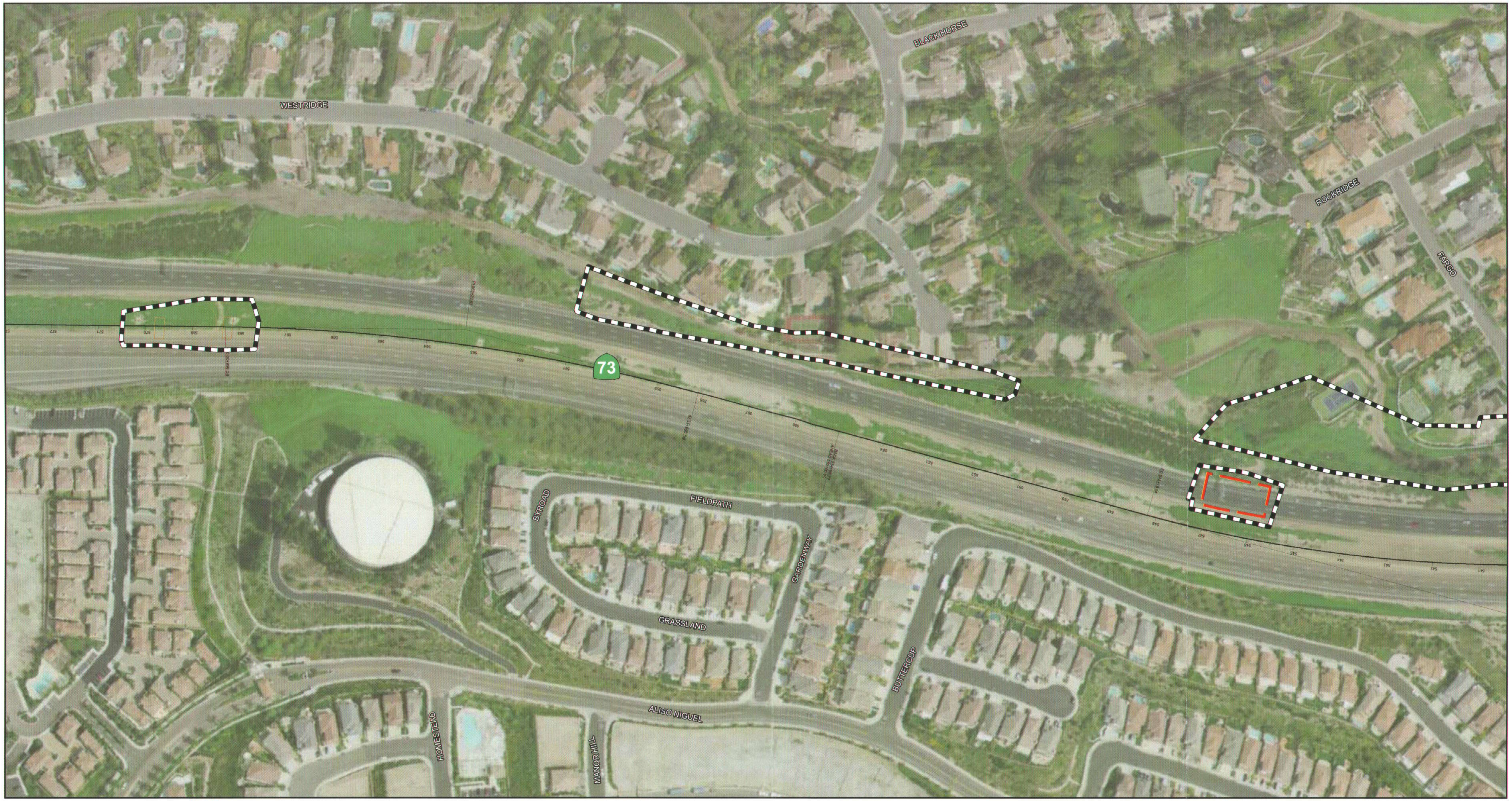
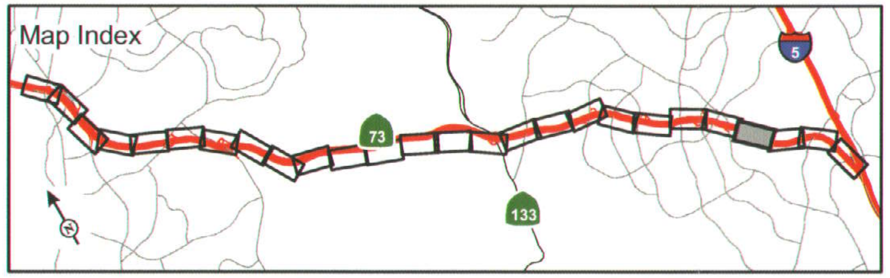


Area of Potential Effects
Planting W/Irrigation
Gravel Access Road
Rip Rap Dissipation
Concrete V-Ditches
Asphalt Concrete Curb
Chainlink Fence
Concrete Catchment Wall
Grading Work W/Topsoil
Paving (Concrete Asphalt, Concrete)

0 100 200 Feet

NOTE: Basin I.D. # - e.g., 457L



APPENDIX A

Sheet 4 of 26

SR-73 Basin Sedimentation Project

Area of Potential Effects

EA# 0H4400

12-ORA-73 PM 10/24.5

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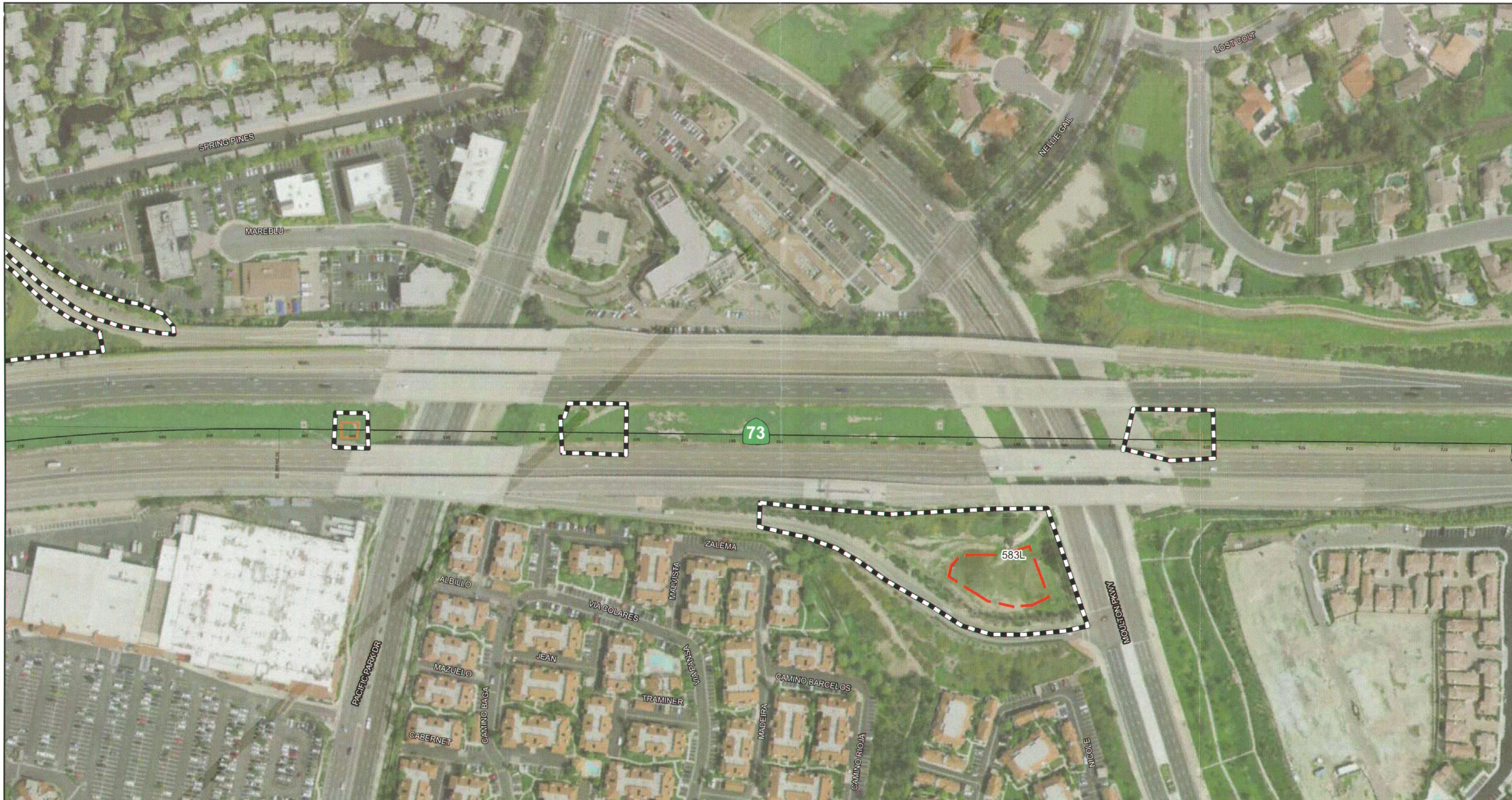
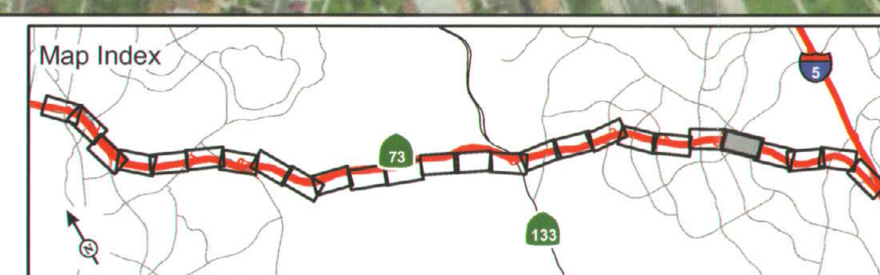


Area of Potential Effects
Planting W/Irrigation
Gravel Access Road
Rip Rap Dissipation
Concrete V-Ditches
Asphalt Concrete Curb
Chainlink Fence
Concrete Catchment Wall
Grading Work W/Topsoil
Paving (Concrete Asphalt, Concrete)

0 100 200 Feet

NOTE: Basin I.D. # - e.g., 457L



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SR-73 Basin Sedimentation Project

Area of Potential Effects

EA# 0H4400

12-ORA-73 PM 10/24.5

SOURCE: DigitalGlobe (4/08)

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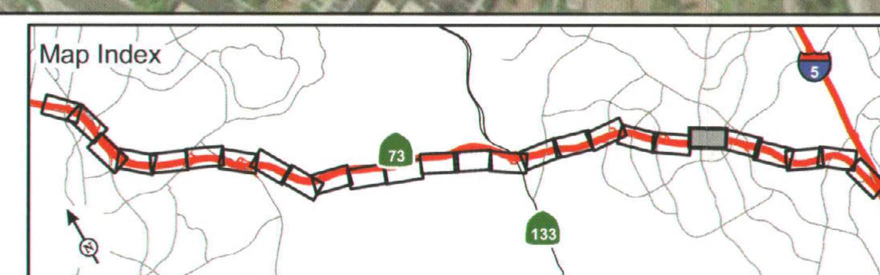

Area of Potential Effects
Planting W/Irrigation
Gravel Access Road
Rip Rap Dissipation
Concrete V-Ditches
Asphalt Concrete Curb
Chainlink Fence
Concrete Catchment Wall
Grading Work W/Topsoil
Paving (Concrete Asphalt, Concrete)

NOTE: Basin I.D. # - e.g., 457L

0 100 200 Feet

SOURCE: DigitalGlobe (4/08)

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SR-73 Basin Sedimentation Project

Area of Potential Effects

EA# 0H4400

12-ORA-73 PM 10/24.5

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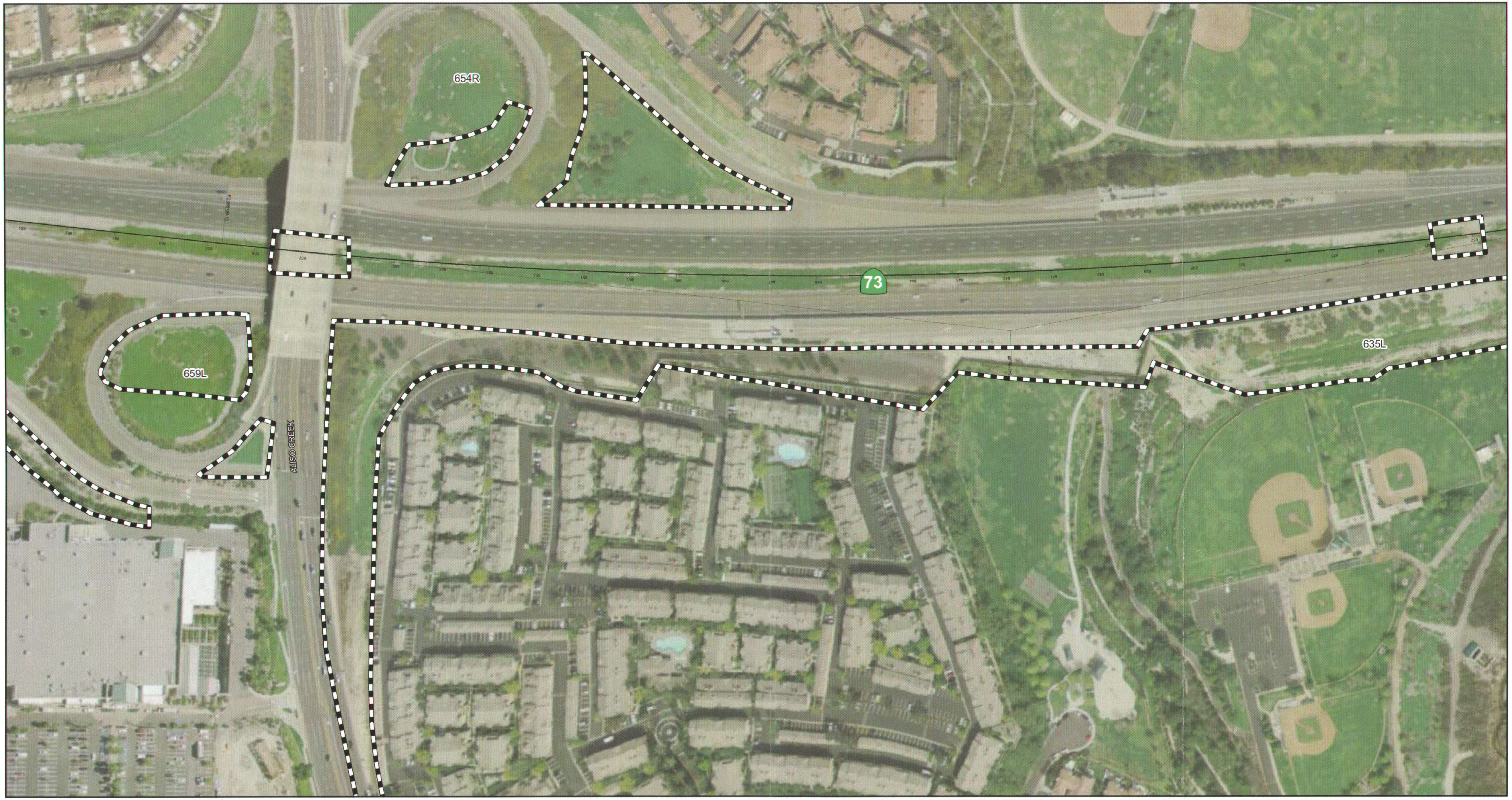

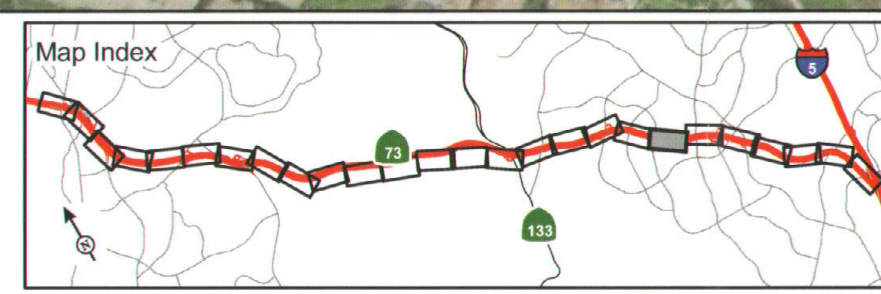

Area of Potential Effects
Planting W/Irrigation
Gravel Access Road
Rip Rap Dissipation
Concrete V-Ditches
Asphalt Concrete Curb
Chainlink Fence
Concrete Catchment Wall
Grading Work W/Topsoil
Paving (Concrete Asphalt, Concrete)

NOTE: Basin I.D. # - e.g., 457L

0 100 200 Feet

SOURCE: DigitalGlobe (4/08)

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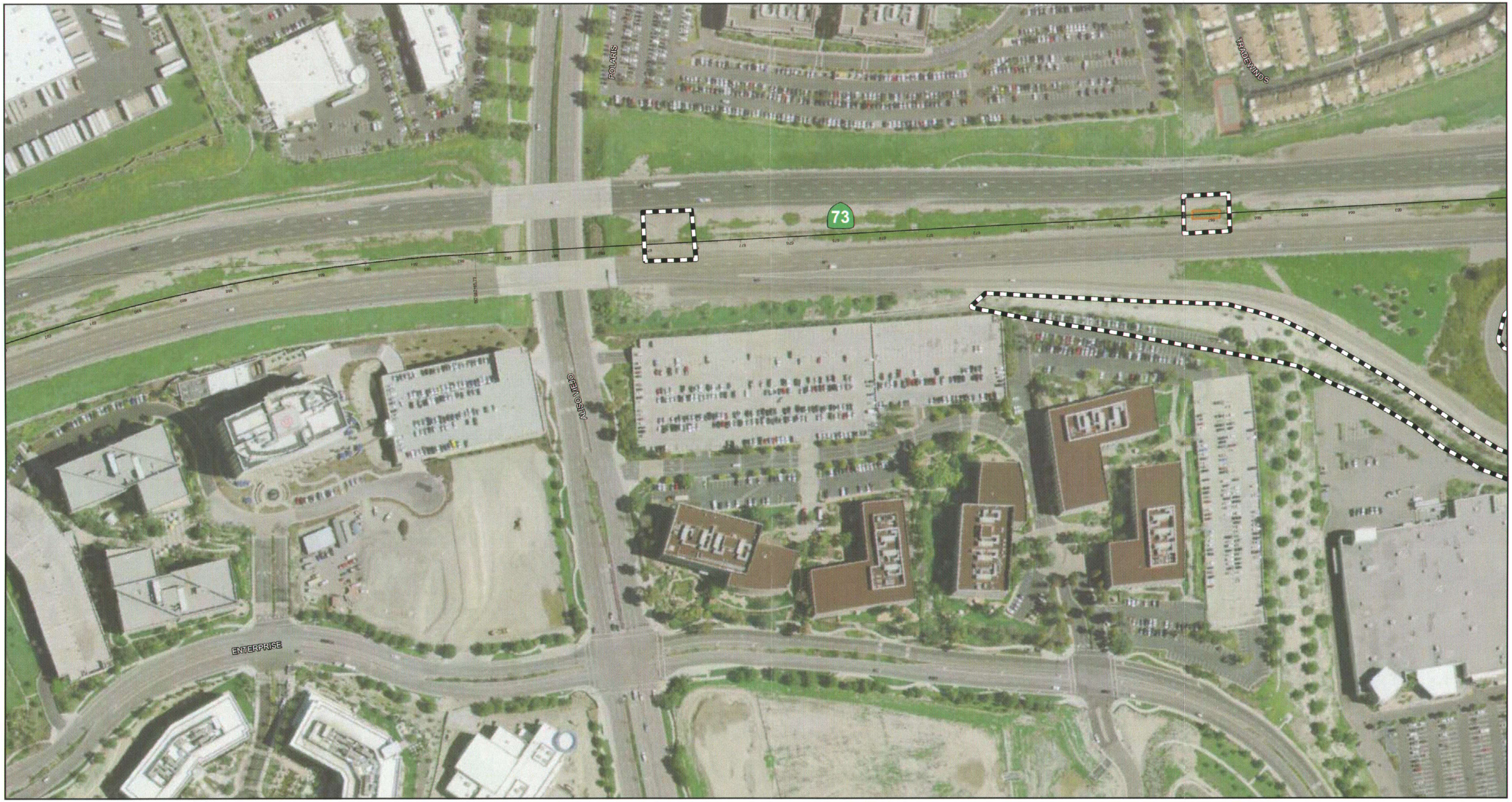
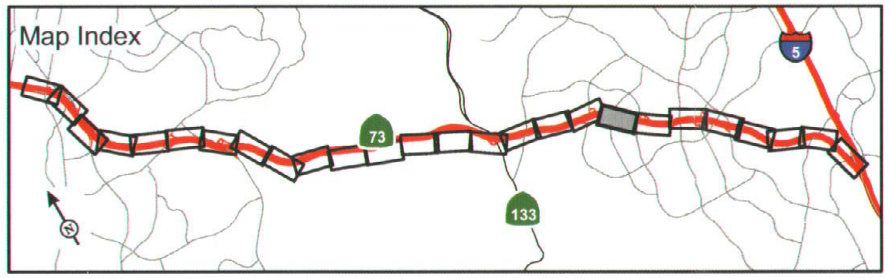
SR-73 Basin Sedimentation Project

Area of Potential Effects

EA# 0H4400
12-ORA-73 PM 10/24.5





Area of Potential Effects
Planting W/Irrigation
Gravel Access Road
Rip Rap Dissipation
Concrete V-Ditches
Asphalt Concrete Curb
Chainlink Fence
Concrete Catchment Wall
Grading Work W/Topsoil
Paving (Concrete Asphalt, Concrete)

0 100 200 Feet

NOTE: Basin I.D. # - e.g., 457L

SOURCE: DigitalGlobe (4/08)

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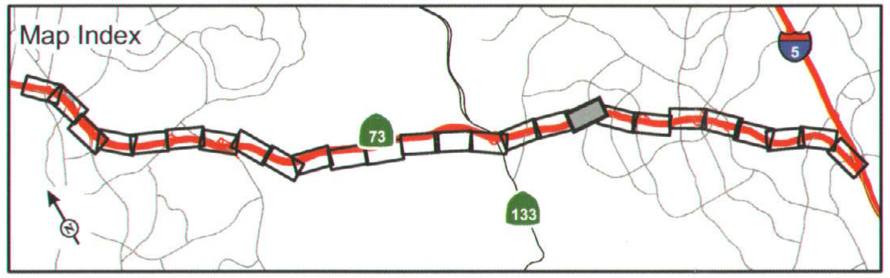
SR-73 Basin Sedimentation Project

Area of Potential Effects

EA# 0H4400

12-ORA-73 PM 10/24.5



0 100 200 Feet

Area of Potential Effects
Planting W/Irrigation
Gravel Access Road
Rip Rap Dissipation
Concrete V-Ditches
Asphalt Concrete Curb
Chainlink Fence
Concrete Catchment Wall
Grading Work W/Topsoil
Paving (Concrete Asphalt, Concrete)

NOTE: Basin I.D. # - e.g., 457L

SOURCE: DigitalGlobe (4/08)

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SR-73 Basin Sedimentation Project

Area of Potential Effects

EA# 0H4400

12-ORA-73 PM 10/24.5

Area of Potential Effects
Planting W/Irrigation
Gravel Access Road
Rip Rap Dissipation
Concrete V-Ditches
Asphalt Concrete Curb
Chainlink Fence
Concrete Catchment Wall
Grading Work W/Topsoil
Paving (Concrete Asphalt, Concrete)

NOTE: Basin I.D. # - e.g., 457L

0 100 200 Feet

SOURCE: DigitalGlobe (4/08)

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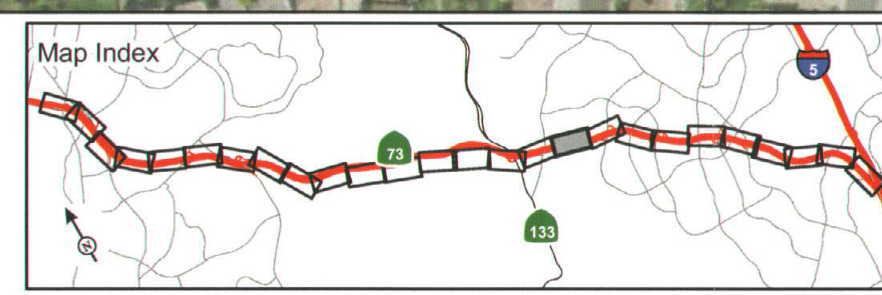

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SR-73 Basin Sedimentation Project

Area of Potential Effects

EA# 0H4400

12-ORA-73 PM 10/24.5

Area of Potential Effects
Planting W/Irrigation
Gravel Access Road
Rip Rap Dissipation
Concrete V-Ditches
Asphalt Concrete Curb
Chainlink Fence
Concrete Catchment Wall
Grading Work W/Topsoil
Paving (Concrete Asphalt, Concrete)

0 100 200 Feet

NOTE: Basin I.D. # - e.g., 457L

SOURCE: DigitalGlobe (4/08)

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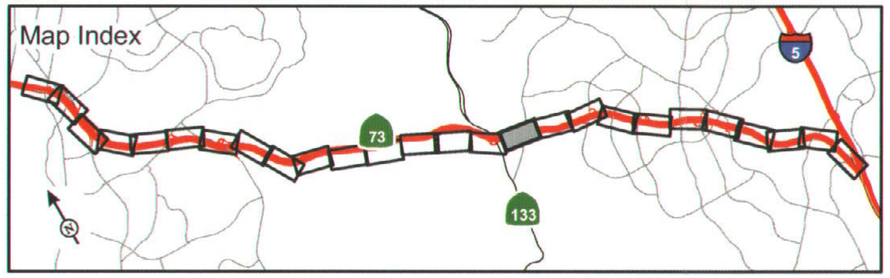

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SR-73 Basin Sedimentation Project

Area of Potential Effects

EA# 0I14400

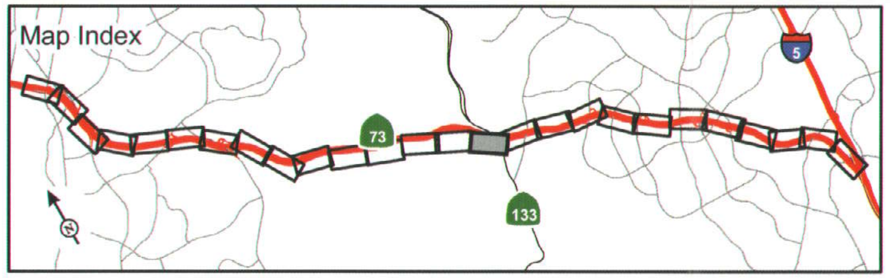
12-ORA-73 PM 10/24.5

Area of Potential Effects
Planting W/Irrigation
Gravel Access Road
Rip Rap Dissipation
Concrete V-Ditches

Asphalt Concrete Curb
Chainlink Fence
Concrete Catchment Wall
Grading Work W/Topsoil
Paving (Concrete Asphalt, Concrete)

0 100 200 Feet

NOTE: Basin I.D. # - e.g., 457L



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SR-73 Basin Sedimentation Project

Area of Potential Effects

EA# 0I14400

12-ORA-73 PM 10/24.5

SOURCE: DigitalGlobe (4/08)

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Area of Potential Effects	Asphalt Concrete Curb
Planting W/Irrigation	Chainlink Fence
Gravel Access Road	Concrete Catchment Wall
Rip Rap Dissipation	Grading Work W/Topsoil
Concrete V-Ditches	Paving (Concrete Asphalt, Concrete)

NOTE: Basin I.D. # - e.g., 457L

0 100 200 Feet

SOURCE: DigitalGlobe (4/08)

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SR-73 Basin Sedimentation Project

Area of Potential Effects

EA# 0H4400

12-ORA-73 PM 10/24.5

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Area of Potential Effects
Planting W/Irrigation
Gravel Access Road
Rip Rap Dissipation
Concrete V-Ditches
Asphalt Concrete Curb
Chainlink Fence
Concrete Catchment Wall
Grading Work W/Topsoil
Paving (Concrete Asphalt, Concrete)

NOTE: Basin I.D. # - e.g., 457L

0 100 200 Feet

SOURCE: DigitalGlobe (4/08)

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SR-73 Basin Sedimentation Project

Area of Potential Effects

EA# 0H4400
12-ORA-73 PM 10/24.5

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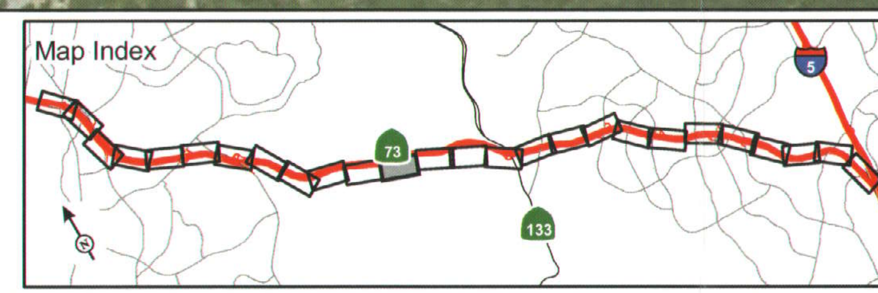
Area of Potential Effects	Asphalt Concrete Curb
Planting W/Irrigation	Chainlink Fence
Gravel Access Road	Concrete Catchment Wall
Rip Rap Dissipation	Grading Work W/Topsoil
Concrete V-Ditches	Paving (Concrete Asphalt, Concrete)

NOTE: Basin I.D. # - e.g., 457L

0 100 200 Feet

SOURCE: DigitalGlobe (4/08)



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SR-73 Basin Sedimentation Project

Area of Potential Effects

EA# 0H4400

12-ORA-73 PM 10/24.5

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Area of Potential Effects
Planting W/Irrigation
Gravel Access Road
Rip Rap Dissipation
Concrete V-Ditches
Asphalt Concrete Curb
Chainlink Fence
Concrete Catchment Wall
Grading Work W/Topsoil
Paving (Concrete Asphalt, Concrete)

NOTE: Basin I.D. # - e.g., 457L

0 100 200 Feet

SOURCE: DigitalGlobe (4/08)

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SR-73 Basin Sedimentation Project

Area of Potential Effects

EA# 0H4400
12-ORA-73 PM 10/24.5

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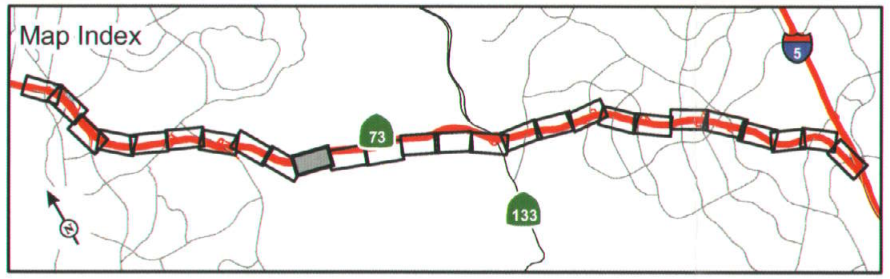

Area of Potential Effects
Planting W/Irrigation
Gravel Access Road
Rip Rap Dissipation
Concrete V-Ditches
Asphalt Concrete Curb
Chainlink Fence
Concrete Catchment Wall
Grading Work W/Topsoil
Paving (Concrete Asphalt, Concrete)

0 100 200 Feet

NOTE: Basin I.D. # - e.g., 457L

SOURCE: DigitalGlobe (4/08)

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SR-73 Basin Sedimentation Project

Area of Potential Effects

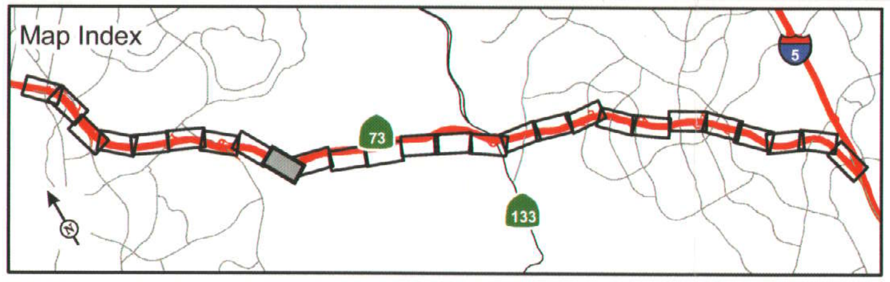
EA# 0H4400
12-ORA-73 PM 10/24.5

Area of Potential Effects
Planting W/Irrigation
Gravel Access Road
Rip Rap Dissipation
Concrete V-Ditches
Asphalt Concrete Curb
Chainlink Fence
Concrete Catchment Wall
Grading Work W/Topsoil
Paving (Concrete Asphalt, Concrete)

NOTE: Basin I.D. # - e.g., 457L

0 100 200 Feet

SOURCE: DigitalGlobe (4/08)



APPENDIX A
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SR-73 Basin Sedimentation Project

Area of Potential Effects

EA# 0H4400
12-ORA-73 PM 10/24.5

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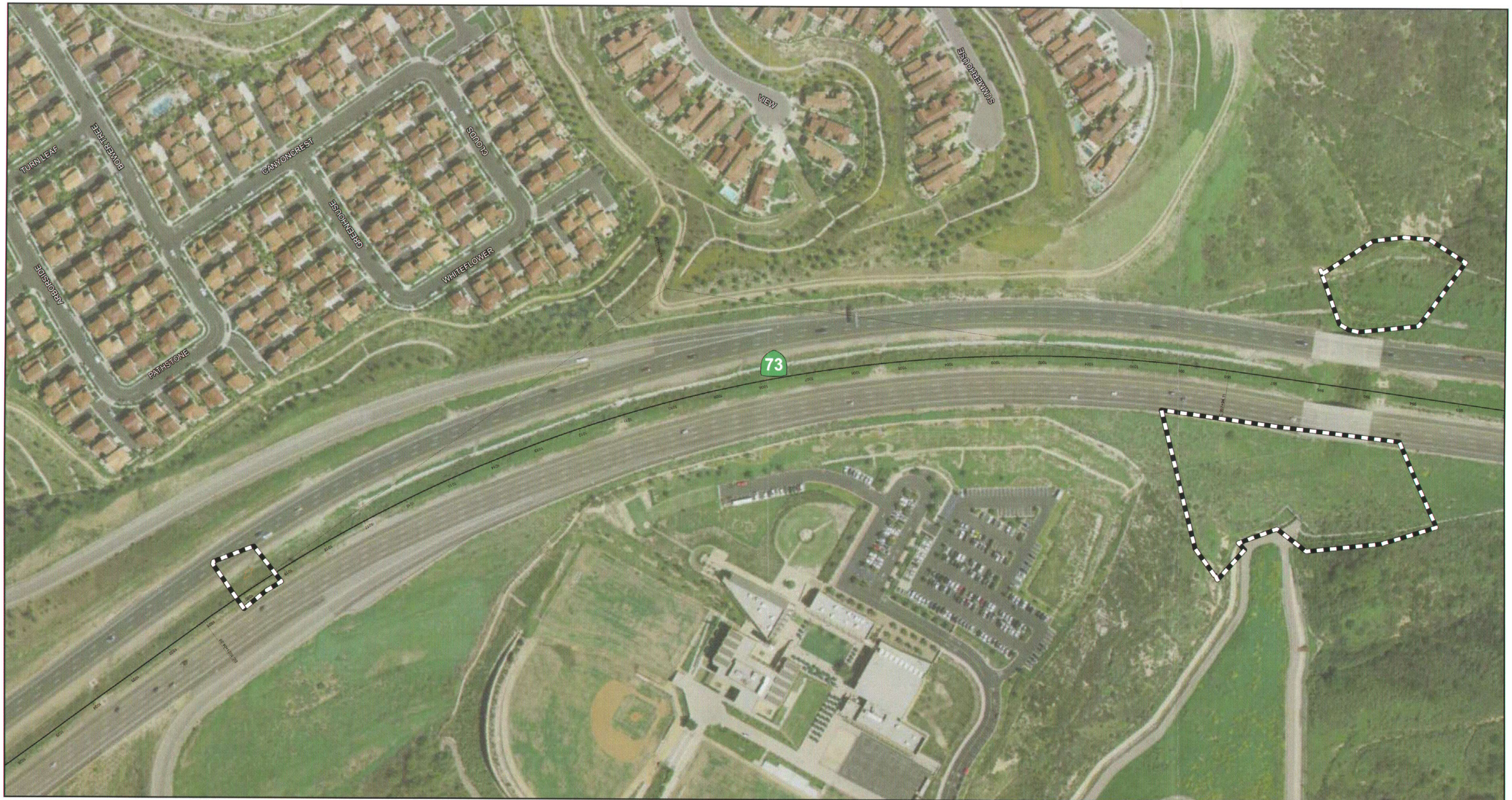

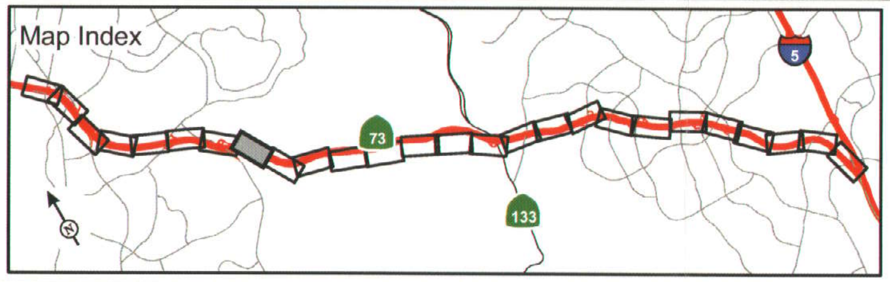

Area of Potential Effects
Planting W/Irrigation
Gravel Access Road
Rip Rap Dissipation
Concrete V-Ditches
Asphalt Concrete Curb
Chainlink Fence
Concrete Catchment Wall
Grading Work W/Topsoil
Paving (Concrete Asphalt, Concrete)

NOTE: Basin I.D. # - e.g., 457L

0 100 200 Feet

SOURCE: DigitalGlobe (4/08)
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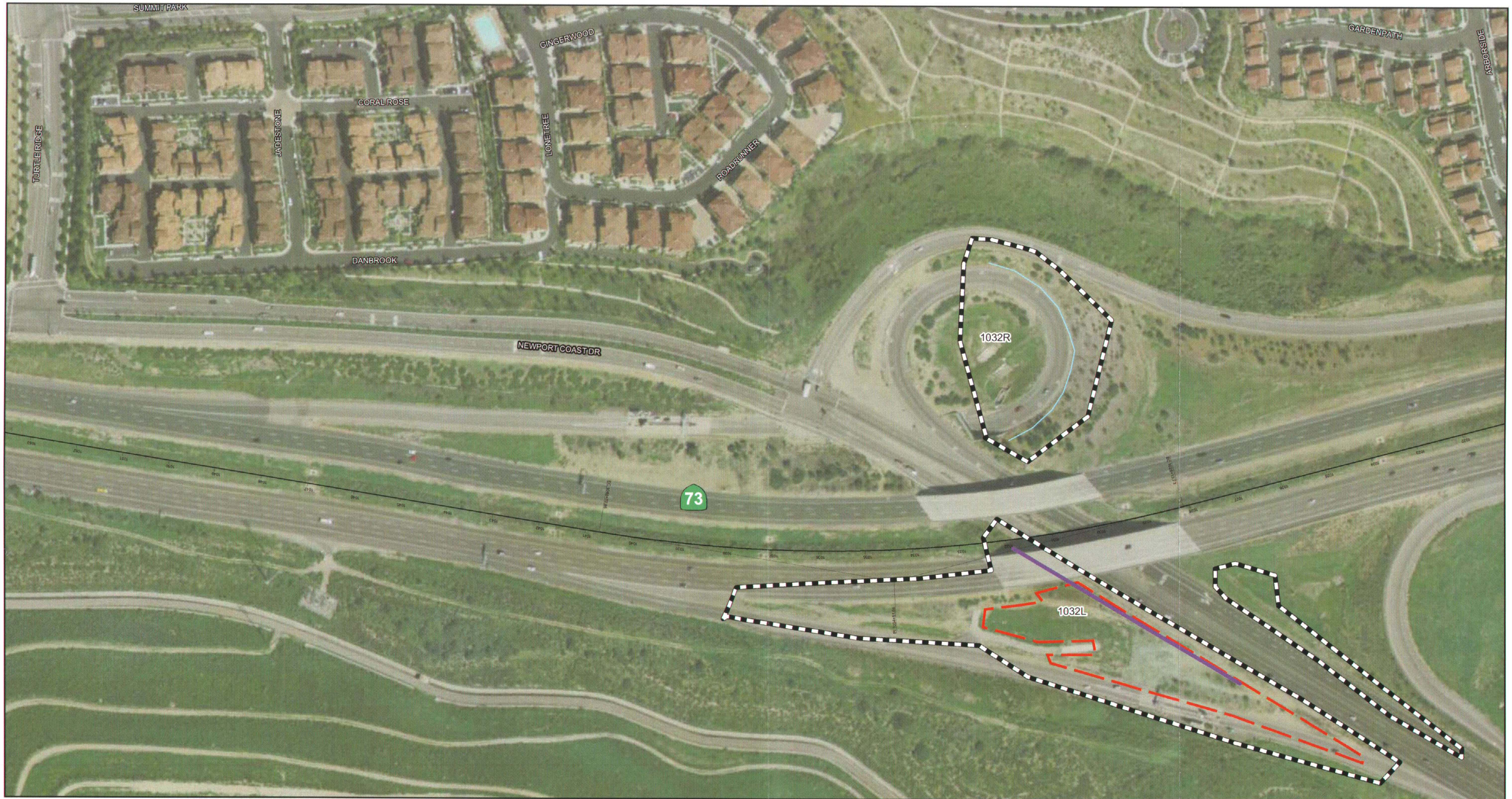
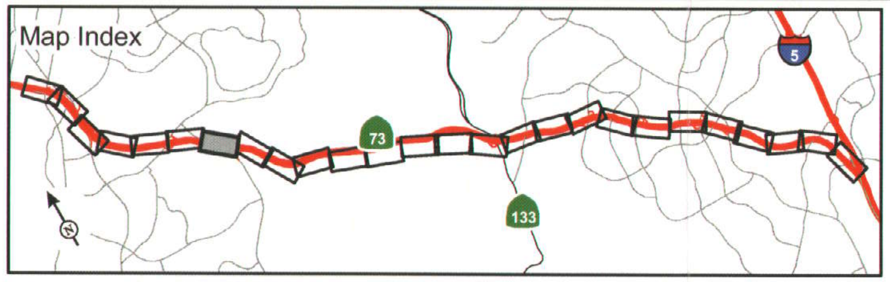
SR-73 Basin Sedimentation Project
Area of Potential Effects
EA# 0H4400
12-ORA-73 PM 10/24.5





0 100 200 Feet

Area of Potential Effects	Asphalt Concrete Curb
Planting W/Irrigation	Chainlink Fence
Gravel Access Road	Concrete Catchment Wall
Rip Rap Dissipation	Grading Work W/Topsoil
Concrete V-Ditches	Paving (Concrete Asphalt, Concrete)

NOTE: Basin I.D. # - e.g., 457L

SOURCE: DigitalGlobe (4/08)

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SR-73 Basin Sedimentation Project

Area of Potential Effects

EA# 0H4400
12-ORA-73 PM 10/24.5

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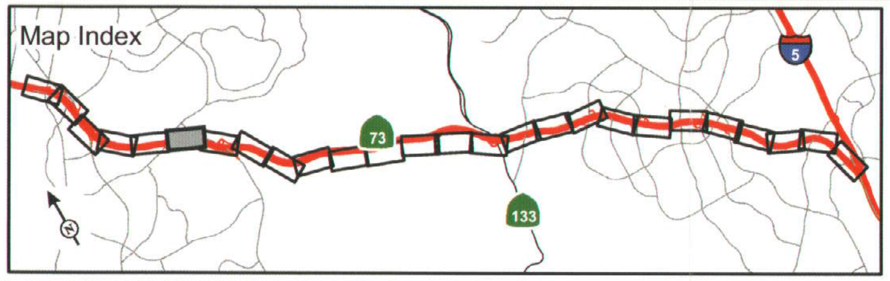

	Area of Potential Effects
	Planting W/Irrigation
	Gravel Access Road
	Rip Rap Dissipation
	Concrete V-Ditches
	Asphalt Concrete Curb
	Chainlink Fence
	Concrete Catchment Wall
	Grading Work W/Topsoil
	Paving (Concrete Asphalt, Concrete)

NOTE: Basin I.D. # - e.g., 457L

0 100 200 Feet

SOURCE: DigitalGlobe (4/08)

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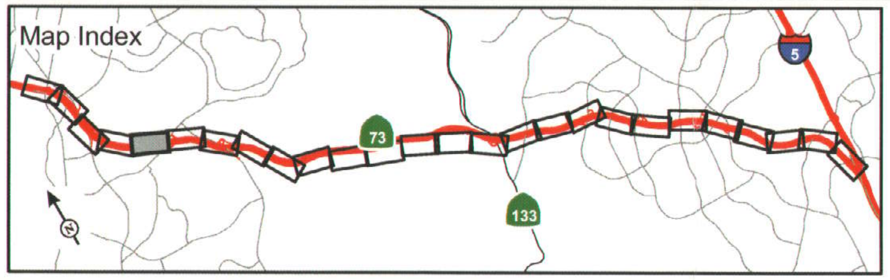
SR-73 Basin Sedimentation Project

Area of Potential Effects

EA# 0H4400

12-ORA-73 PM 10/24.5



Area of Potential Effects
Planting W/Irrigation
Gravel Access Road
Rip Rap Dissipation
Concrete V-Ditches
Asphalt Concrete Curb
Chainlink Fence
Concrete Catchment Wall
Grading Work W/Topsoil
Paving (Concrete Asphalt, Concrete)

NOTE: Basin I.D. # - e.g., 457L

0 100 200 Feet

SOURCE: DigitalGlobe (4/08)

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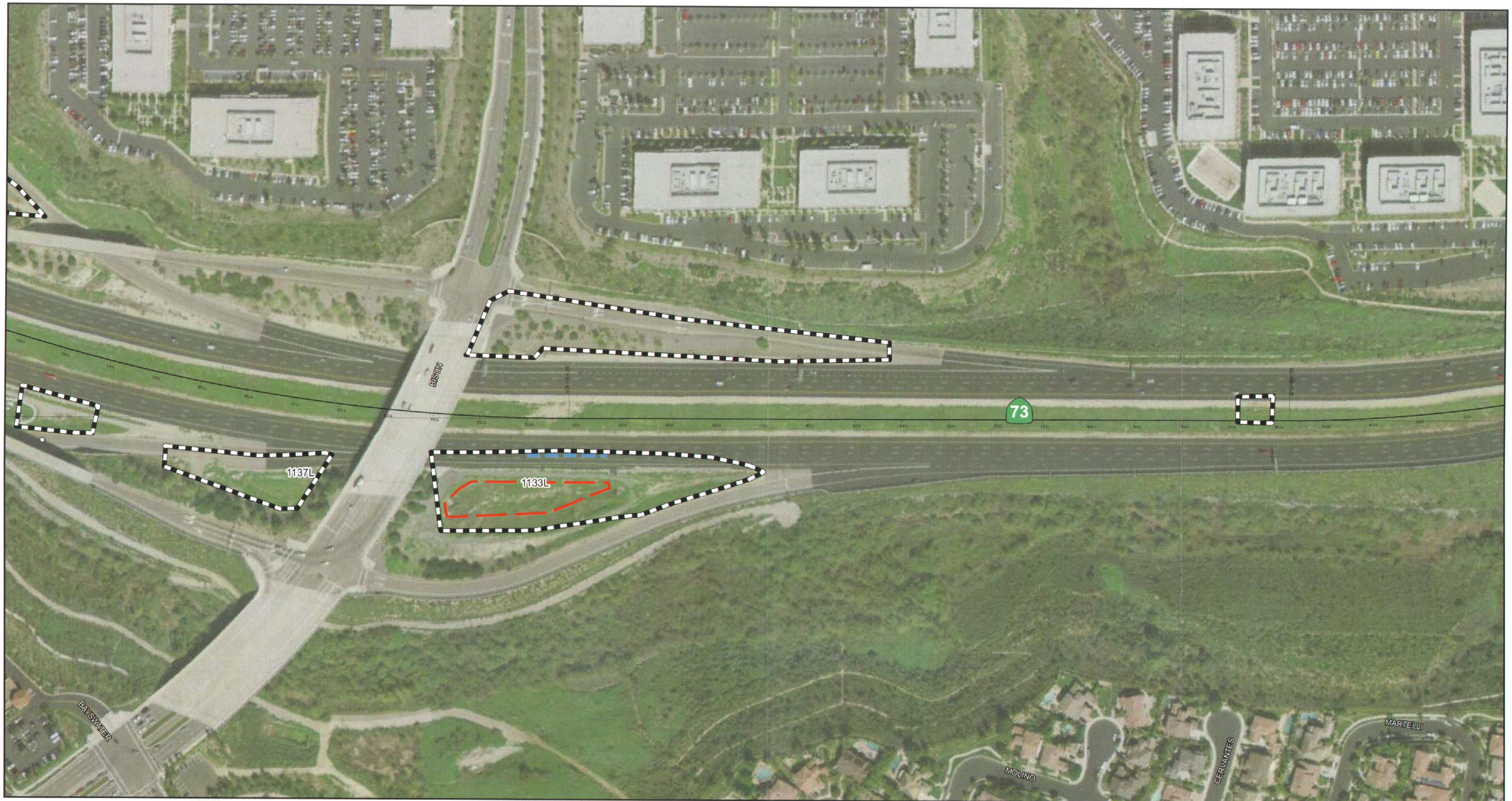
SR-73 Basin Sedimentation Project

Area of Potential Effects

EA# 0H4400

12-ORA-73 PM 10/24.5



Area of Potential Effects
Planting W/Irrigation
Gravel Access Road
Rip Rap Dissipation
Concrete V-Ditches
Asphalt Concrete Curb
Chainlink Fence
Concrete Catchment Wall
Grading Work W/Topsoil
Paving (Concrete Asphalt, Concrete)

NOTE: Basin I.D. # - e.g., 457L

0 100 200 Feet

SOURCE: DigitalGlobe (4/08)

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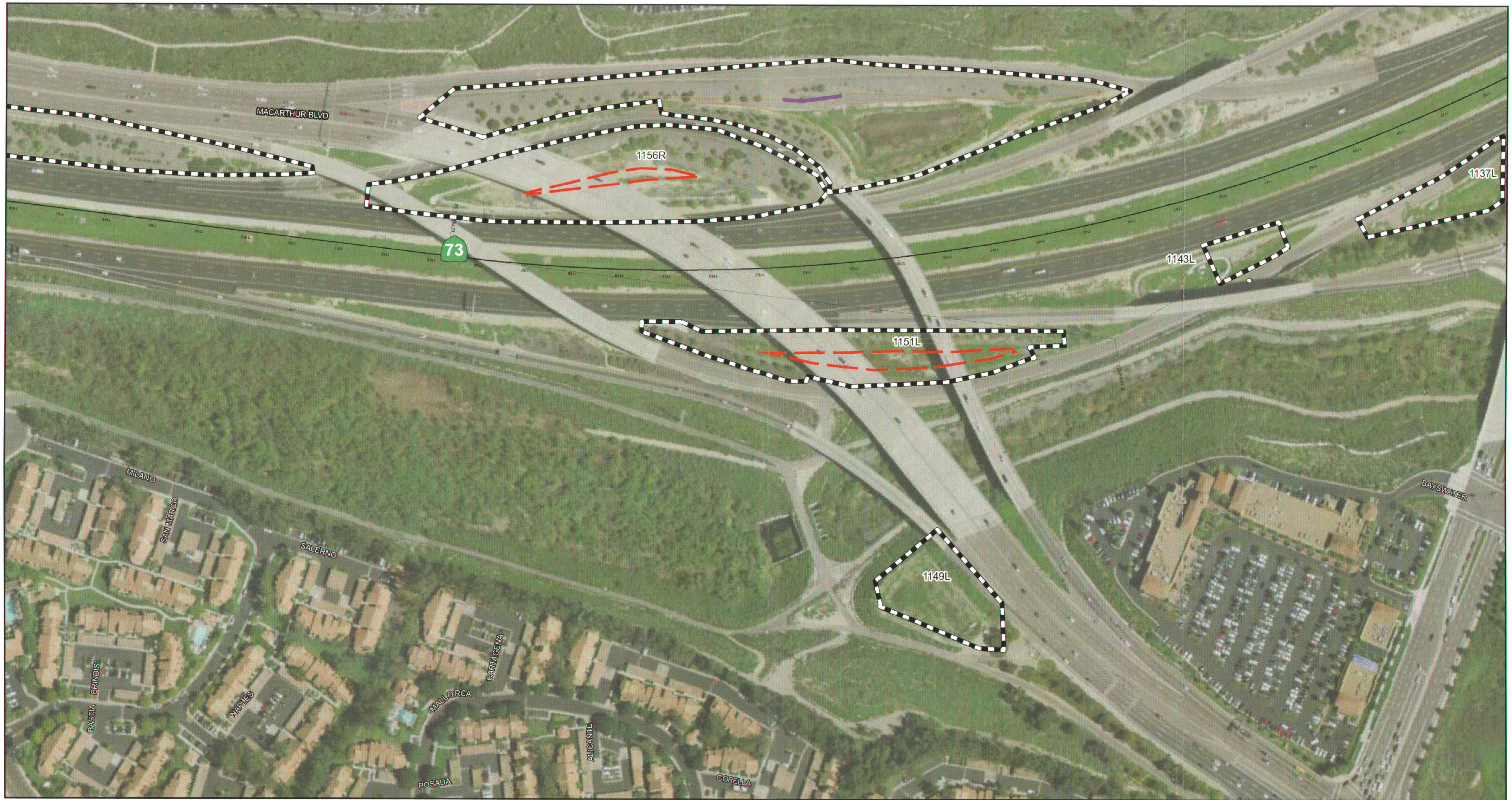
SR-73 Basin Sedimentation Project

Area of Potential Effects

EA# 0H4400

12-ORA-73 PM 10/24.5



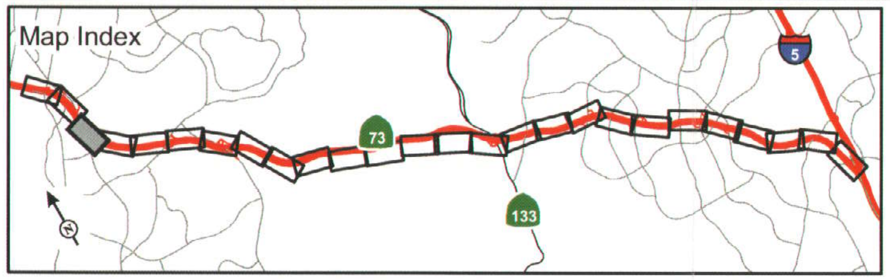
Area of Potential Effects
Planting W/Irrigation
Gravel Access Road
Rip Rap Dissipation
Concrete V-Ditches

Asphalt Concrete Curb
Chainlink Fence
Concrete Catchment Wall
Grading Work W/Topsoil
Paving (Concrete Asphalt, Concrete)

NOTE: Basin I.D. # - e.g., 457L

0 100 200 Feet

SOURCE: DigitalGlobe (4/08)



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SR-73 Basin Sedimentation Project

Area of Potential Effects

EA# 0H4400

12-ORA-73 PM 10/24.5

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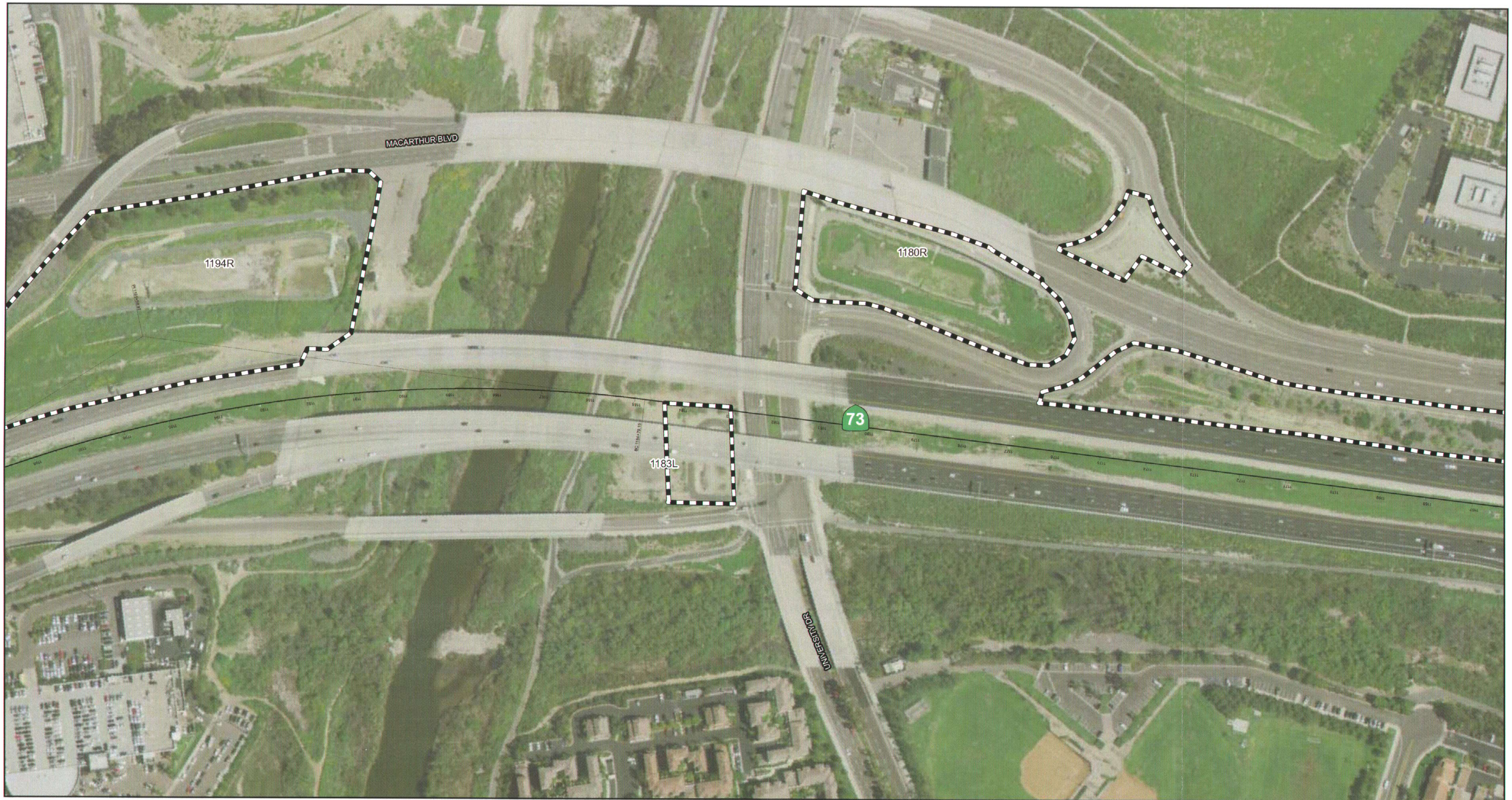
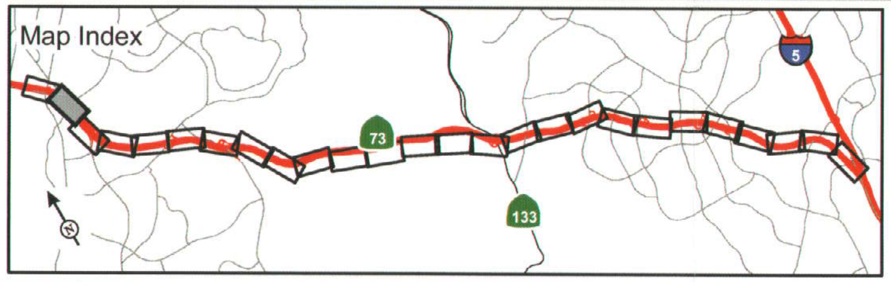


Area of Potential Effects
Planting W/Irrigation
Gravel Access Road
Rip Rap Dissipation
Concrete V-Ditches
Asphalt Concrete Curb
Chainlink Fence
Concrete Catchment Wall
Grading Work W/Topsoil
Paving (Concrete Asphalt, Concrete)

NOTE: Basin I.D. # - e.g., 457L

0 100 200 Feet

SOURCE: DigitalGlobe (4/08)



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SR-73 Basin Sedimentation Project

Area of Potential Effects

EA# 0H4400

12-ORA-73 PM 10/24.5

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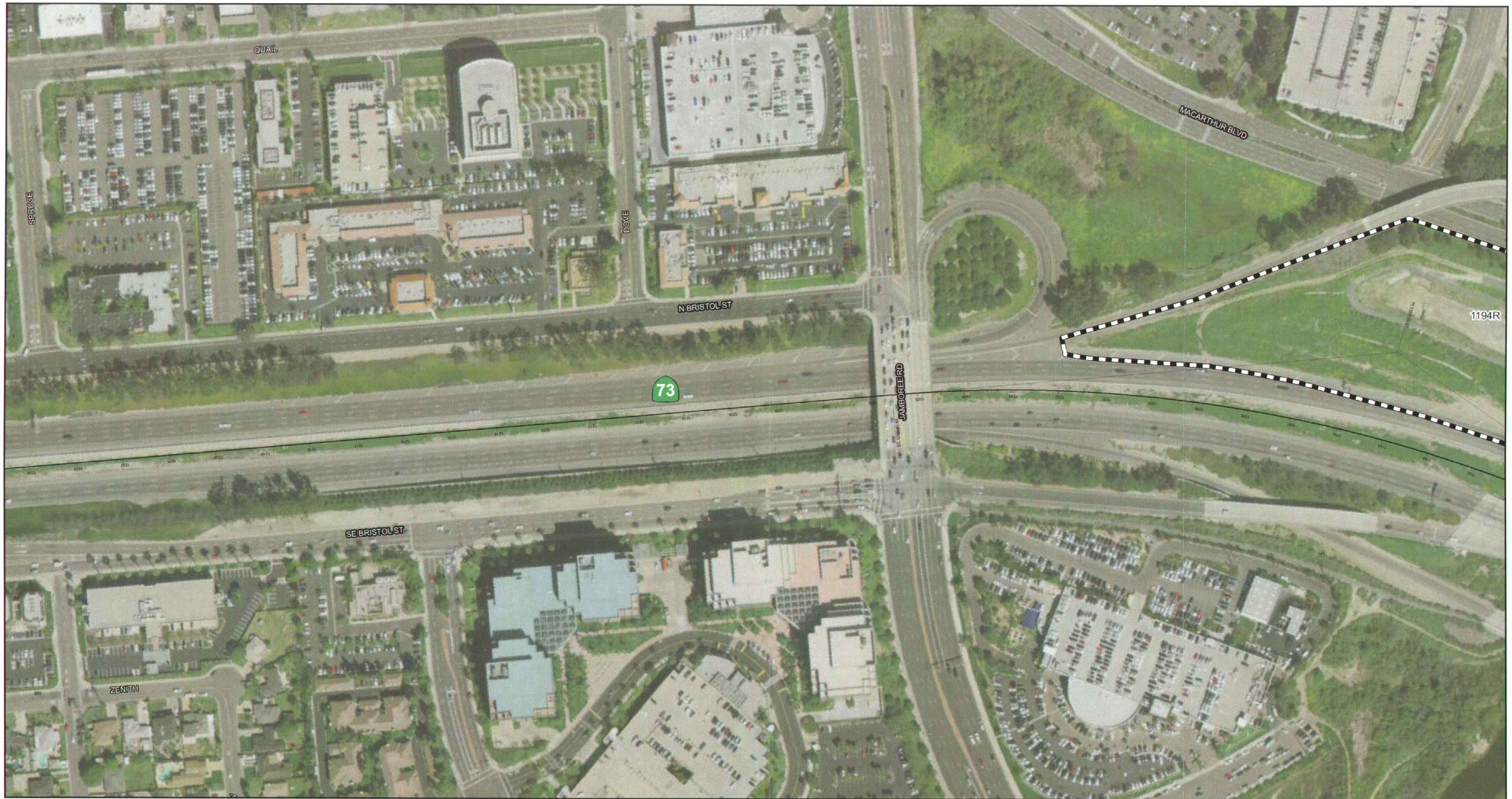
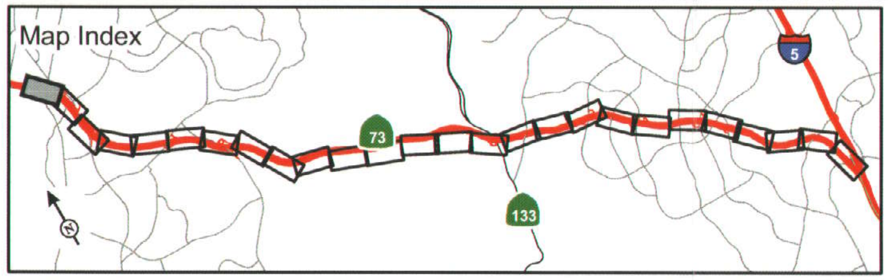


Area of Potential Effects
Planting W/Irrigation
Gravel Access Road
Rip Rap Dissipation
Concrete V-Ditches
Asphalt Concrete Curb
Chainlink Fence
Concrete Catchment Wall
Grading Work W/Topsoil
Paving (Concrete Asphalt, Concrete)

NOTE: Basin I.D. # - e.g., 457L

0 100 200 Feet

SOURCE: DigitalGlobe (4/08)



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SR-73 Basin Sedimentation Project

Area of Potential Effects

EA# 0H4400
12-ORA-73 PM 10/24.5

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APPENDIX B

SUMMARY OF LEGISLATION

APPENDIX B: SUMMARY OF LEGISLATION

Laws, Regulations, and Guidance

This section summarizes federal and State laws and regulations pertaining to paleontological resources and how these integrate with project development and delivery activities. Policies and/or contact information for federal and State land managing and regulatory agencies that have paleontological authorities and responsibilities are provided directly or by hotlink. In the event that a project involves land owned or administered by another federal or State agency, that agency should be contacted in order to ascertain specific requirements they may have relative to paleontological resources. In addition to federal and State requirements, project proponents may also be subject to local ordinances concerning paleontological resources. Local ordinances are not summarized in this document, and local entities such as cities and counties should be contacted to determine if there are additional local requirements that must be met.

Federal Legislation

A variety of federal statutes specifically address paleontological resources. They generally become applicable to specific projects if that delivery crosses federal lands or involves a federal agency license, permits, approval, or funding.

Antiquities Act of 1906 (16 United States Code [USC] 431-433). The Antiquities Act of 1906 states, in part, "That any person who shall appropriate, excavate, injure or destroy any historic or prehistoric ruin or monument, or any object of antiquity, situated on lands owned or controlled by the Government of the United States, without the permission of the Secretary of the Department of the Government having jurisdiction over the lands on which said antiquities are situated, shall upon conviction, be fined in a sum of not more than five hundred dollars or be imprisoned for a period of not more than ninety days, or shall suffer both fine and imprisonment, in the discretion of the court." Although there is no specific mention of natural or paleontological resources in the Act itself, or in the Act's uniform rules and regulations (Title 43 Part 3, Code of Federal Regulations [43 CFR 3]), "objects of antiquity" has been interpreted to include fossils by the National Park Service (NPS), the Bureau of Land Management (BLM), the Forest Service (FS), and other federal agencies. Permits to collect fossils on lands administered by federal agencies are authorized under this Act (see Permit Requirements of Federal Agencies section, below). Therefore, projects involving federal lands will require permits for both paleontological resource evaluation and mitigation efforts.

Archaeological and Paleontological Salvage (23 USC 305). Statute 23 USC 305 amends the Antiquities Act of 1906. Specifically, it states, "Funds authorized to be appropriated to carry out this title to the extent approved as necessary, by the highway department of any State, may be used for archaeological and paleontological salvage in that state in compliance with the Act entitled 'An Act for the preservation of American Antiquities,' approved June 8, 1906 (PL 59-209; 16 USC 431-433), and State laws where applicable."

This statute allows funding for mitigation of paleontological resources recovered pursuant to federal aid highway projects, provided that "excavated objects and information are to be used for public purposes without private gain to any individual or organization" (Federal Register [FR] 46(19): 9570; [Also see Federal Highway Administration (FHWA) policy section, below]).

Federal-Aid Highway Act of 1935 (20 USC 78). Section 305 of the Federal Aid Highway Act of 1956 (20 USC 78, 78a) gives the FHWA authority to use federal funds to salvage archaeological and paleontological sites affected by highway projects.

National Registry of Natural Landmarks (16 USC 461-467). The National Natural Landmarks (NNL) program was established in 1962 and is administered under the Historic Sites Act of 1935. Implementing regulations were first published in 1980 under 36 CFR 1212, and the program was redesignated as 36 CFR 62 in 1981. A National Natural Landmark is defined as:

> *...an area designated by the Secretary of the Interior as being of national significance to the United States because it is an outstanding example(s) of major biological and geological features found within the boundaries of the United States or its Territories or on the Outer Continental Shelf (36 CFR 62.2).*

National significance describes:

> *... an area that is one of the best examples of a biological community or geological feature within a natural region of the United States, including terrestrial communities, landforms, geological features and processes, habitats of native plant and animal species, or fossil evidence of the development of life (36 CFR 62.2).*

Federal agencies (e.g., FHWA) and their agents (e.g., the California Department of Transportation [Department]) should consider the existence and location of designated NNLs, and of areas found to meet the criteria for national significance, in assessing the effects of their activities on the environment under Section 102(2)(c) of the National Environmental Policy Act (NEPA) (42 USC 4321). The NPS is responsible for providing requested information about the NNL Program for these assessments (36 CFR 62.6(f)). However, other than consideration under NEPA, NNLs are afforded no special protection. Furthermore, there is no requirement to evaluate a paleontological resource for listing as an NNL. Finally, project proponents (State and local) are not obligated to prepare an application for listing potential NNLs should such a resource be encountered during project planning and delivery.

Examples of paleontological NNLs in California include:

- Rancho La Brea—Hancock Park, Wilshire Boulevard, Los Angeles
- Sharktooth Hill—Kern County

- Rainbow Basin—near Barstow, San Bernardino County

For an up-to-date listing of NNLs in California, visit the NNL Web site.

National Historic Preservation Act of 1966 (NHPA; 16 USC 470). Section 106 of the NHPA does not apply to paleontological resources unless the paleontological specimens are found in culturally related contexts (e.g., fossil shell included as a mortuary offering in a burial or a culturally related site, such as a petrified wood locale used as a chipped stone quarry). In such instances, the materials are considered cultural resources and are treated in the manner prescribed for the site in question, mitigation being almost exclusively limited to sites determined eligible for or listed on the National Register of Historic Places. It should be emphasized that cooperation between the cultural resource and paleontological disciplines is expected in such instances.

Section 4(f) of the Department of Transportation Act of 1966 (23 USC 138; 49 USC 1653). Section 4(f) of the Department of Transportation Act does not specifically address paleontological resources. This section of the law places restrictions on the ability of FHWA to take publicly owned 4(f) properties (which include parks, recreation areas, wildlife or waterfowl refuges, and National Register of Historic Places eligible or listed properties). Paleontological resources would only be addressed under this law if located within a 4(f) property.

National Environmental Policy Act of 1969 (42 USC 4321). NEPA directs federal agencies to use all practicable means to "Preserve important historic, cultural, and natural aspects of our national heritage..." (Section 101(b) (4)). Regulations for implementing the procedural provisions of NEPA are found in 40 CFR 1500 1508.

If the presence of a significant environmental resource is identified during the scoping process, federal agencies and their agents must take the resource into consideration when evaluating project effects. Consideration of paleontological resources may be required under NEPA when a project is proposed for development on federal land or land under federal jurisdiction. The level of consideration depends upon the federal agency involved (see section entitled Identification of Regulatory/Management Agencies, below).

- **1872 Mining Law, amended 1988.** Excludes fossils (including petrified wood) from claim or patent. United States Forest Service and Bureau of Land Management regulate the surface effects of development under this law. BLM regulations specifically state that operators may not knowingly disturb or destroy any scientifically important paleontological remains on federal lands; that they must notify an authorized officer of such finds; and that said officer shall take action to protect or remove the resource(s).
- **Mineral Leasing Act of 1920 (sec. 30).** Requires and provides for the protection of interest of the United States. Natural resources, including paleontologic resources, are commonly regarded as such interests.

- **Executive Order 11593, May 31, 1971, Protection and Enhancement of the Cultural Environment (36 CFR 8921).** Requires federal agencies to inventory and protect properties under their jurisdiction. National Park Service regulations under 36 CFR provide that paleontologic specimens may not be disturbed or removed without a permit.
- **Archaeological and Historic Data Preservation Act of 1974 (P.L. 86-253, as amended by P.L. 93-921, 16 USC 469).Act of May 24, 1974 (88 Stat 174, sec. 3 a0, 4a).** Provides for the survey, recovery, and preservation of significant scientific, prehistoric, historic, archaeological, or paleontological data when such data may be destroyed or irreparably lost due to a federal, federally licensed, or federally funded project. A Statement of Program Approach was published in the *Federal Register* on March 26, 1979 (40 FR 18117), to advise the manner in which this law will be implemented.
- **36 CFR Part 800 (39 FR 3365, January 25, 1974, and 44 FR 6068, January 30, 1979)**: Procedures for the protection of historic and cultural properties. Establishes procedures to ensure that historic and cultural resources are given proper consideration in the preparation of environmental impact statements.
- **Federal Land Management and Policy Act of 1976 (FLPMA, P.L. 94-579, 43 USC 1701-1782).** Provides authority for BLM to regulate lands under its jurisdiction, managed in a manner to "protect the quality of scientific, scenic, historic, ecological, environmental...and archaeological values." Authority is given to establish areas of critical environmental concern (ACEC).
- **Surface Mining Control and Reclamation Act of 1977 (SMCRA, P.L. 95-87, 30 USC 1201-1328).** Regulates surface coal mining and provides designation as unsuitable for surface mining if mining would "...result in significant damage to important cultural, scientific, and esthetic values and natural systems...."
- **Paleontological Resource Management 1998, Bureau of Land Management Handbook H-8270-1.** General Procedural Guidance for Paleontological Management.

State of California Legislation

The following State laws and regulations are applicable, or potentially applicable, to the Department and locally sponsored projects.

California Environmental Quality Act of 1970 (CEQA, 13 PRC, 2100, et seq.). Requires identification of potential adverse impacts of a project to any object or site of scientific importance (Div. 1, PRC 5020.1(b)).

The California Environmental Quality Act (CEQA) (Chapter 1, Section 21002) states that:

> *...it is the policy of the state that public agencies should not approve projects as proposed if there are feasible alternatives or feasible mitigation measures available which would substantially lessen the significant environmental effects of such projects, and that the procedures required are intended to assist public agencies in systematically identifying both the significant effects of proposed projects and the*

feasible alternatives or feasible mitigation measures which will avoid or substantially lessen such significant effects.

Guidelines for the Implementation of the California Environmental Quality Act, as amended May 10, 1980 (14 Cal. Admin. Code: 15000, et seq.). Requires mitigation of adverse impacts to a paleontologic site from development on public land by construction monitoring.
The CEQA Guidelines (Article 1, Section 15002(a)(3)) state that CEQA is intended to prevent significant, avoidable damage to the environment by requiring changes in projects through the use of alternatives or mitigation measures when the governmental agency finds the changes to be feasible.

Guidelines for the Implementation of CEQA, 1992, Appendix G, section J (Significant effects). CEQA Guidelines, Appendix G, states, in part, that: "A project will 'normally' have a significant effect on the environment if it, among other things, will disrupt or adversely affect …a paleontological site except as part of a scientific study." If paleontological resources are identified during the Preliminary Environmental Analysis Report (PEAR) or other initial project scoping studies as being within the proposed project area, the sponsoring agency (the Department or local) must take those resources into consideration when evaluating project effects. The level of consideration may vary with the importance of the resource.

Periodic review of CEQA-related court cases for decisions related to paleontology is also recommended. These cases can be found at the California Environmental Resources Evaluation System (CERES) Web site.

California Environmental Quality Act, State of California Public Resources Code, 2100-21177 as amended January 1, 1999, Appendix G Environmental Checklist Form. Impacts to known, important paleontological resources are specifically covered under CEQA as potentially significant effects (i.e., the project will have a significant effect on the environment). Specifically, each California project must answer the question: "Cultural Resource – would the project directly or indirectly destroy a unique paleontological resource or site or unique geological feature?" There are four possible answers: Potentially Significant Impact, Potentially Significant Unless Mitigation Incorporated, Less than Significant Impact, and No Impact.

California Coastal Act. The California Coastal Act, in part, authorizes the California Coastal Commission (CCC) to review permit applications for development within the coastal zone and, where necessary, to require reasonable mitigation measures to offset effects of that development. Permits for development are issued with "special conditions" to ensure implementation of these mitigation measures.

Section 30244 of the Act, "Archaeological or Paleontological Resources," states that where development would adversely impact archaeological or paleontological resources, as identified by the State Historic Preservation Officer, reasonable mitigation measures shall be required.

If the CCC determines that a paleontological resource is present within an applicant's proposed project area, they generally look for evidence that the applicant has taken the resource into consideration (e.g., through formal survey by a professional paleontologist, with implementation of resulting recommendations). If a paleontological site is present, special permit conditions may range from avoidance of the site to construction monitoring and/or salvage of significant fossils. This approach virtually parallels the level of protection afforded to paleontological resources by CEQA. Additionally, the CCC relies heavily on project sponsoring or permitting agencies to ensure compliance with CEQA (and, consequently, the California Coastal Act).

Warren-Alquist Act (PRC 25000 et seq.). Requires the California Energy Commission to evaluate energy facility siting in unique areas of scientific concern (Section 26627).

Public Resources Code, Section 5097.5 (State 1965, c. 1136, p. 2792). Section 50987.5 of the California Public Code Section states: "No person shall knowingly and willfully excavate upon, or remove, destroy, injure or deface any historic or prehistoric ruins, burial grounds, archaeological or vertebrate paleontological site, including fossilized footprints, inscriptions made by human agency, or any other archaeological, paleontological or historical feature, situated on public lands, except with the express permission of the public agency having jurisdiction over such lands. Violation of this section is a misdemeanor."

As used in this section, "public lands" means lands owned by, or under the jurisdiction of, the State; any city, county, district, authority, or public corporation; or any agency thereof. Consequently, the Department and local project proponents are required to comply with PRC 5097.5 for their own activities, including construction and maintenance, as well as for permit actions (e.g., encroachment permits) undertaken by others.

Public Resources Code, Section 30244. Requires reasonable mitigation of adverse impacts to paleontological resources from development on public land.

California Administrative Code. Four sections of the California Administrative Code (Title 14, State Division of Beaches and Parks) administered by the California Department of Parks and Recreation CDPR) address paleontological resources. These include:

- **Section 4306: Geological Features** – "No person shall destroy, disturb, mutilate, or remove earth, sand, gravel, oil, minerals, rocks, or features of caves."
- **Section 4307: Archaeological Features** – "No person shall remove, injure, disfigure, deface, or destroy any object of paleontological, archaeological, or historical interest or value."
- **Section 4308: Property** – "No person shall disturb, destroy, remove, deface, or injure any property of the state park system. No person shall cut, carve, paint, mark, paste, or fasten on any tree, fence, wall, building, monument, or other property in the state parks, any bill, advertisement, or inscription."

- **Section 4309: Special Permits** – "Upon a finding that it will be for the best interest of the state park system and for state park purposes, the director may grant a permit to remove, treat, disturb, or destroy plants or animals or geological, historical, archaeological, or paleontological materials; and any person who has been properly granted such a permit shall to that extent not be liable for prosecution for violation of the foregoing."

These sections of the California Administrative Code establish authority and processes to protect paleontological resources while allowing mitigation through the permit process.

Local Laws and Regulations

Various cities and counties have passed ordinances and resolutions related to paleontological resources within their jurisdictions. Examples include the Counties of Orange, Riverside, and San Bernardino and the Cities of San Diego, Carlsbad, Palmdale, and Chula Vista. These regulations generally provide additional guidance on assessment and treatment measures for projects subject to CEQA compliance. Project staff should periodically coordinate with local entities to update their knowledge of local requirements.

Further Reference

Additional information is posted on the SVP's Web site. In the event that a project involves lands administered by either federal or State entities, the local offices of those organizations should also be contacted for guidance and direction.

APPENDIX C

NATURAL HISTORY MUSEUM OF LOS ANGELES COUNTY LOCALITY SEARCH RESULTS LETTER

Natural History
of Los Angeles County

900 Exposition Boulevard • Los Angeles, CA 90007

Vertebrate Paleontology Section
Telephone: (213) 763-3325
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24 December 2008

LSA Associates, Inc.
20 Executive Park, Suite 200
Irvine, California 92614-4731

Attn: Brooks Smith, Cultural & Paleontological Resources Group

re: Paleontological Resources Records Search for the proposed 39 Basins along State Route 73, LSA Project # CDT0807 Task 4, Orange County, project area

Dear Brooks:

I have thoroughly searched our paleontology collection records for the locality and specimen data for the proposed 39 Basins along State Route 73, LSA Project # CDT0807 Task 4, Orange County, project area as outlined on the portions of the Tustin, Laguna Beach, and San Juan Capistrano USGS topographic quadrangle maps that you sent to me via e-mail on 3 December 2008. We do not have any fossil vertebrate localities that lie directly within the proposed project route area, but we do have localities nearby from the same or similar sedimentary deposits as occur in the proposed project area.

In the very northwestern part of the proposed project route area the initial basins have surficial deposits consisting of younger Quaternary Alluvium, derived primarily as fluvial deposits from the San Diego Creek drainage. These deposits also occur surficially in all of the canyons and drainages crossed by the proposed project route area. The adjacent elevated terrain in this portion of the proposed project route area has surficial older Quaternary terrace deposits, either marine or terrestrial, that overlie deposits of the marine Pliocene Niguel Formation or the marine middle Miocene Topanga Formation that are exposed at the base of the hills near MacArthur Boulevard. As the proposed project route continues east-southeastward it crosses more extensive exposures of the Topanga Formation down to about the intersection of State Road 73 and Newport Coast Drive where it crosses some exposures of intrusive volcanic rocks, then crosses more expansive exposures of the Topanga Formation. Just south of the upper reaches of Shady Canyon the proposed project route crosses smaller exposures of intrusive volcanic rocks as well as exposures of the Paleocene Silverado Formation, the marine early Miocene Vaqueros Formation, and the terrestrial early Miocene Sespe Formation. Eastward past Laguna Canyon Road and El Toro Road, with their drainages containing surficial deposits of younger Quaternary Alluvium, the proposed project route crosses more exposures of the Sespe

Formation. As the proposed project route approaches the ridge east of El Toro Road it crosses small exposures of the Vaqueros Formation and greater exposures of the middle Miocene San Onofrio Breccia. From there southeastward to the eastern side of Aliso Creek the proposed project route crosses exposures of the marine late Miocene Monterey Formation. From just above the base of the hills on the eastern side of Aliso Creek eastward to the terminus near the intersection of the San Diego Freeway (I-5) and Crown Valley Parkway, the proposed project route crosses exposures of mostly the marine late Miocene Capistrano Formation, with pocket exposures of the overlying marine Pliocene Niguel Formation.

In the very northwestern portion of the proposed project route area our closest vertebrate fossil localities from older Quaternary terrace deposits are LACM 1068-1069 and 1086 south of University Drive and east of MacArthur Boulevard, as well as LACM 1066, 1240, 3407, 3877, 4426 and 6732 between MacArthur Boulevard westward to about Eastbluff Drive and south to about Ford Road. These localities, and many more closer to Upper Newport Bay, produced a rich suite of Quaternary fossil vertebrates with many, especially mammals, documented by W.E. Miller in his 1971 publication, and many of the amphibians and reptiles by D.M. Hudson and B.H. Brattstrom in their 1977 publication. The composite fossil fauna from these localities, and a list of scientific publications citing specimens from these localities, are provided in appendices to this report [see appendices A & B].

In the eastern portion of the proposed project route area, between La Paz Road and Moulton Park way just north of the proposed project route area, we have the older Quaternary vertebrate fossil localities LACM 4628-4629 that produced fossil specimens of mammoth, *Mammuthus*, bison, *Bison*, horse, *Equus*, and a tapir, *Tapirus californicus*. The latter was published in the scientific literature by G.T. Jefferson (1989. Late Cenozoic Tapirs (Mammalia: Perissodactyla) of Western North America. Contributions in Science, Natural History Museum of Los Angeles County, 406:1-21).

In the same general vicinity of the Quaternary terrace deposits in the western portion of the proposed project route area, our closest vertebrate fossil localities from the Niguel Formation, along MacArthur Boulevard south to Ford Road and west along Ford Road to Jamboree Road, are LACM 1067, 1729, 2019, 3408, 3977-3978, 3980, and 3986. These localities have produced a substantial fossil fauna and specimens of various taxa from the localities have been published in the scientific literature. The composite fossil fauna from these localities, and a list of scientific publications citing specimens from these localities, are provided in appendices to this report [see appendices C & D].

In the eastern portion of the proposed project route area our closest vertebrate fossil localities from the Niguel Formation are LACM 3804, almost directly north of the eastern terminus of the proposed project route area just south of Oso Parkway, and LACM 5551, further north near the intersection of La Paz Road and Paseo de Valencia. From these localities we recovered fossil specimens of white shark, *Carcharodon sulcidens*, dugong, Dugongidae, sea lion, Otariidae, and extinct baleen whale, *Herpetocetus*.

Most of our closest vertebrate fossil localities from the Topanga Formation are south to southwest of the eastern portion of the proposed project route area. These localities include LACM 3222, on the west side of Aliso Creek canyon approximately due east of the intersection of the Pacific Coast Highway (Highway 1) and Bluebird Canyon Drive, that produced a fossil specimen of the rare and peculiar four-legged marine mammal of the Desmostylia, *Desmostylus*; locality LACM 7249, on top of the ridge north of Temple Hill, that produced a fossil specimen of the sea cow *Dioplotherium allisoni* figured in the scientific literature by D. P. Domning (1978. Sirenian Evolution in the North Pacific Ocean. University of California Publications in Geological Sciences, 118:1-176); and locality LACM 4007, in Rim Rock Canyon west of Temple Hill, that produced a fossil specimen of sea cow, Dugongidae. Northeast of the eastern portion of the proposed project route area our vertebrate fossil locality LACM 6064, east of Marguerite Parkway between La Paz Road and Oso Parkway, produced a nearly complete skeleton of another desmostylian, *Paleoparadoxia*.

Our only vertebrate fossil locality from the Silverado Formation is LACM 4634, northeast of the proposed project route area near Silverado, that produced a fossil specimen of undetermined turtle, Testudinata.

Our closest vertebrate fossil localities from the Vaqueros Formation are LACM 7505, 7548-7553, 7675-7678, and 7712, all situated northeast of the central portion of the proposed project route area in the San Joaquin Hills immediately south of the San Diego Freeway (I-405) and west of the Laguna Reservoir. These localities have produced highly significant vertebrate fossils including specimens of eagle ray, *Myliobatis*, requiem sharks, Carcharinidae, basking shark, *Cetorhinus*, extinct four-legged marine mammals, Desmostylia, extinct toothed whales, *Argyrocetus*, Platanistidae, and Squalodontidae, and extinct baleen whales, Eomysticetidae and Cetotheriidae.

Our closest vertebrate fossil localities from the Sespe Formation are LACM 5448, 6935, 6938, 6940-6945, and 7326-7328. Locality LACM 5448 is situated northeast of the eastern portion of the proposed project route area just above Borrego Canyon Wash east of the former El Toro Marine Corp Air Station and the other localities occur around Bee Canyon northeast of the former El Toro Marine Corp Air Station. These localities have produced a suite of terrestrial fossil vertebrates including alligator lizard, *Gerrhonotus*, iguana, *Parasauromalus*, opposum, *Nanodelphys*, oreodonts, *Merychyus*, *Oreodontoides*, and *Sespia*, dogs, *Mesocyon* and *Vulpes*, pika, *Cuyamalagus*, wood rat, *Leidymys*, pocket gopher, *Schizodontomys*, pocket mice, *Mookomys*, *Perognathus*, and *Proheteromys*, and squirrels, *Miospermophilus*, *Nototamias*, and *Protosciurus*.

We have no vertebrate fossil localities from the San Onofrio Breccia and its coarse nature makes finding significant vertebrate fossils from that rock unit unlikely.

Our closest vertebrate fossil localities from the Monterey Formation to the western portion of the proposed project route area are LACM 1160 and 7139, southwest of the western portion of the proposed project route area in the bluffs along Backbay Drive west of Jamboree Road and south of San Joaquin Hills Road, that produced undetermined fossils of bony fish, Osteichthyes and baleen whale, Mysticeti.

In the eastern portion of the proposed project route area our closest vertebrate fossil localities from the Monterey Formation to the north are LACM 3863, 4919, 5143-5145, and 5786, situated roughly between Aliso Creek and La Paz Road, that produced fossil specimens of herring, *Ganolytes cameo*, snake mackerel, *Thyrsocles kriegeri*, sculpin, Cottidae, walrus, *Imagotaria*, extinct baleen whale, *Herpetocetus*, and sperm whale, *Scaldicetus*. The latter specimen is a nearly complete skeleton of a juvenile sperm whale published in the scientific literature by S.A. McLeod (1988. A Fossil Sperm Whale from Orange County, California. Memoirs of the Natural History Foundation of Orange County, 2:22-28).

In the eastern portion of the proposed project route area our closest vertebrate fossil localities from the Monterey Formation to the south are LACM 1101, 3185, 3541, south of Pacific Park Drive and west of Aliso Creek Road, and LACM 7305 and 7431, around Heather Ridge south of Pacific Park Drive. These localities produced a composite fossil fauna including bonito shark, *Isurus hastalis*, eagle ray, *Myliobatidae*, scad, *Decapterus*, snake mackerel, *Thyrsocles kriegeri*, mackerel, Scombridae, leatherback turtle, *Psephophorus*, murrelet, *Praemancalla wetmorei*, booby, *Morus lompocanus*, shearwater, *Puffinus barnesi*, sea lion, *Allodesmus kernensis*, dolphin, *Pithanodelphis nasalis*, baleen whale, *Mixocetus*, and dugong, *Dusisiren jordani*. From these localities the skeleton of the fossil sea lion *Allodesmus kernensis* was published in the scientific literature (Downs, 1955; also see Mitchell, 1961 & 1966 and Barnes, 1985) [see appendices E & F for a list of the taxa of published specimens by locality from the nearby Monterey Formation localities and a list of publications on the LACM specimens from those localities]. The fossil dolphin *Pithanodelphis nasalis* was published by L.G. Barnes (1985, 1988). H. Howard (1978) and R.M. Chandler (1990) published on a specimen of the fossil booby *Morus lompocanus*, while H. Howard (1978, 1982) published on a specimen of the fossil flightless auk *Praemancalla wetmorei*, and H. Howard (1978) also published on a specimen of the fossil shearwater *Puffinus barnesi*. An incomplete skeleton of the fossil sea cow *Dusisiren jordani* was published on by D.P. Domning (1978).

We have numerous vertebrate fossil localities from the Monterey Formation slightly farther south of this portion of the proposed project route area in the general area of the ridge where the Chet Holifield Federal Building was constructed, from Alicia Parkway to just east to La Paz Road and from just north of Avila Road to just south of Aliso Creek Road, and several of these sites have produced spectacular vertebrate fossil specimens as well as the holotypes (name bearing specimens) of new species of fossil vertebrates. A considerable number of these Monterey Formation localities, LACM 5065-5083 and 6901-6906, were discovered during excavations for what is now the Chet Holifield Federal Building. The extensive composite fauna from these localities and those mentioned above is provided in appendix E. H. Howard named four new species of fossil sea birds from these localities: loon, *Gavia brodkorbi* (Howard, 1978; see also Chandler, 1990), booby, *Morus magnus* (Howard, 1978), flightless auk *Preamancalla* *wetmorei* (Howard, 1976; see also Howard, 1978 and 1982), and fossil shearwater *Puffinus barnesi* (Howard, 1978). Furthermore, Barnes named the species of extinct dolphin *Pithanodelphis nasalis* (Barnes, 1985; see also Barnes, 1988 and Muizon, 1989).

Other notable fossil specimens from the Chet Holifield Building localities include partial skeletons of a sea turtle *Chelonia*, a dugong, *Dusisiren jordani*, and a sea lion *Imagotaria*. Uncommon or rare taxa from these localities include a chimaera *Hydrolagus colliei*, sabretooth salmon *Smilodonichthyes rastrosus*, false-toothed bird *Osteodontornis orri*, the extinct quadrupedal marine mammal *Desmostylus*, beluga whale, Monodontidae, and beaked whale, Ziphiidae.

Our closest vertebrate fossil localities to the proposed project route area from the Capistrano Formation are LACM 4630 and 5465, south of the eastern portion of the proposed project route area north of Avila Road between La Paz Road and Moulton Parkway, and LACM 3184 and 3867, just south of the eastern terminus of the proposed project route area north of Crown Valley Parkway. These localities produced a small composite fauna including chimaera, Chimaeridae, requiem sharks, Carchrinidae, dogfish, Sqaulidae, undetermined bony fish, Teleostei, puffin, Alcidae, porpoise, Phocoenidae, and blue whale, *Balaenoptera musculus*. The latter specimen was published in the scientific literature by L.G. Barnes *et al.* (1984. A fossil baleen whale from the Capistrano Formation in Laguna Hills, California. Memoirs of the Natural History Foundation of Orange County, 1:11-18). Further to the south of this portion of the proposed project route area we have several vertebrate fossil localities from the Capistrano Formation including LACM 3748, 3820, 3862, 4496, 5473-5574, 5506, and 6626-6627, all situated around La Paz Road north of the Sulphur Creek Reservoir to around Avila Road. These localities produced a suite of fossil marine vertebrates (see a appendix G for the composite fauna) including a sturgeon, *Acipenser*, published in the scientific literature by E.J. Hilton and L. Grande (2006. Review of the fossil record of sturgeons, family Acipenseridae (Actinopterygii: Acipenseriformes), from North America. Journal of Paleontology, 80(4):672-683) and dugongs, *Hydrodamalis cuestae*, published in the scientific literature by D.P. Domning (1978. Sirenian Evolution in the North Pacific Ocean. University of California Publications in Geological Sciences, 118:1-176), D.P. Domning and H. Furusawa (1994. Summary of taxa and distribution of Sirenia in the North Pacific Ocean. The Island Arc, 3(4):506-512) and S. Kobayashi *et al.* (1995. A New Species of Sirenia (Mammalia: Hydrodamalinae) from the Shiotsubo Formation in Takasato, Aizu, Fukushima Prefecture, Japan. Journal of Vertebrate Paleontology, 15(4):815-829).

Excavations in the intrusive volcanic rocks exposed in some portion of the San Joaquin Hills will not encounter any vertebrate fossils. Excavations in the San Onofre Breccia exposed in the central portion of the proposed project route area probably will not encounter any significant vertebrate fossils. Grading or shallow excavations in the uppermost few feet of the younger Quaternary Alluvium exposed in all of the drainages and other less elevated portions of the proposed project route area not likely to uncover significant fossil vertebrate remains. Deeper excavations in the those latter areas that extend down older sedimentary deposits, however, may well encounter significant vertebrate fossils. Any excavations in the older Quaternary terrace deposits, the Niguel Formation, the Capistrano Formation, the Monterey Formation, the Topanga Formation, the Vaqueros Formation, the Sespe Formation, or the Silverado Formation are quite likely to encounter significant to highly significant vertebrate fossils. Except for the portions with exposures of volcanic rocks and the San Onofre Breccia, the paleontological sensitivity of the proposed project route area is rated high. Any substantial excavations in the proposed project route area exclusive of volcanic rocks and the San Onofre Breccia, therefore, should be closely monitored to quickly and professionally collect any specimens without impeding development. Any fossils recovered during mitigation should be deposited in an accredited and permanent scientific institution for the benefit of current and future generations.

Sincerely,

Samuel A. McLeod

Samuel A. McLeod, Ph.D.
Vertebrate Paleontology

enclosures: appendices, draft invoice

Appendix A

Composite fossil fauna based on LACM specimens from Quaternary terrace deposit localities between Upper Newport Bay and the University of California at Irvine

Chondrichthyes
- Carcharhiniformes
  - Carcharhinidae - requiem sharks
    - *Galeocerdo*
    - *Galeorhinus zyopterus*
    - *Negaprion*
    - *Prionace*
  - Sphyrnidae - hammerhead sharks
    - *Sphyrna*
  - Triakidae - houndsharks
    - *Triakis semifasciata*
- Chimaeriformes
  - Chimaeridae - chimaeras
    - *Hydrolagus colliei*
- Heterodontiformes
  - Heterodontidae - horn sharks
    - *Heterodontus francisci*
- Hexanchiformes
  - Hexanchidae - cow sharks
    - *Hexanchus*
- Lamniformes
  - Alopiidae - thresher sharks
    - *Alopias vulpinus*
  - Cetorhinidae - basking sharks
    - *Cetorhinus maximus*
  - Lamnidae - mackerel sharks
    - *Carcharocles megalodon*
    - *Carcharodon carcharias*
    - *Carcharodon sulcidens*
    - *Isurus glaucus*
    - *Isurus oxyrinchus*
    - *Lamna ditropis*
- Myliobatiformes
  - Myliobatidae - eagle rays
    - *Myliobatis californicus*
  - Urolophidae - sting rays
    - *Urolophus*
- Squaliformes
  - Echinorhinidae - bramble sharks
    - *Echinorhinus*
  - Squalidae - dogfish sharks
    - *Scymnodon ringens*
    - *Squalus acanthias*
- Squatiniformes
  - Squatinidae - angel sharks
    - *Squatina californica*

Osteichthyes
- Anguilliformes
  - Ophichthidae - snake eels
    - *Ophichthus*
- Batrachoidiformes
  - Batrachoididae - toadfishes
    - *Porichthys myriaster*
- Ophidiiformes
  - Ophidiidae - cusk eels
    - *Otophidium scrippsi*
    - *Otophidium taylori*
- Perciformes
  - Istiophoridae - billfish
  - Labridae - wrasses
    - *Pimelometopon pulchrum*
  - Sciaenidae - croakers
    - *Cynoscion nobilis*
    - *Genyonemus lineatus*
    - *Seriphus politus*
  - Serranidae - groupers
    - *Stereolepis gigas*
  - Sparidae - porgies
- Pleuronectiformes
  - Bothidae - sanddabs
    - *Paralichthys*
  - Pleuronectidae - flounders
    - *Parophrys vetulus*
- Scorpaeniformes
  - Cottidae - sculpins
    - *Leptocottus armatus*

Amphibia
- Anura
  - Bufonidae - toads
    - *Bufo boreas*
  - Hylidae - tree frogs
    - *Hyla regillo*
  - Ranidae - true frogs
    - *Rana aurora*
- Urodela
  - Plethodontidae - lungless salamanders
    - *Aneides lugubris*

Reptilia
- Squamata
  - Colubridae - common snakes
    - *Coluber*
    - *Lampropeltis getulus*
    - *Masticophis flagellum*
    - *Thamnophis*
  - Crotalidae - rattlesnakes
    - *Crotalus viridus*
- Testudinata
  - Cheloniidae - sea turtles
    - *Chelonia mydas*
  - Testudinidae - tortoises

Aves
- Accipitriformes
  - Accipitridae - hawks
    - *Accipiter*
    - *Haliaeetus*
- Anseriformes
  - Anatidae - ducks
    - *Anser albifrons*
    - *Aythya affinis*
    - *Branta canadensis*
    - *Chendytes lawi*
    - *Melanitta deglandi*
- Charadriiformes
  - Alcidae - auks & murres
    - *Mancalla californiensis*
  - Laridae - gulls
    - *Larus*
  - Scolopacidae - sandpipers
    - *Catoptrophorus inornatus*
  - Stercorariidae - jaegers
    - *Stercorarius*
- Galliformes
  - Phasianidae - quail
    - *Lophortyx*
- Gaviiformes
  - Gaviidae - loons
    - *Gavia arctica*
    - *Gavia immer*
    - *Gavia stellata*
- Passeriformes
  - Corvidae - crows
    - *Corvus*
- Passeriformes
  - Icteridae - blackbirds
    - *Agelaius*

Aves
- Pelecaniformes
  - Phalacrocoracidae - cormorants
    - *Phalacrocorax penicillatus*
  - Sulidae - boobies
    - *Morus reyana*
- Podicipediformes
  - Podicipedidae - grebes
    - *Aechmophorus occidentalis*
- Procellariiformes
  - Diomedeidae - albatrosses
    - *Diomedea albatrus*
  - Procellariidae - shearwaters
    - *Fulmarus glacialis*
    - *Puffinus griseus*
    - *Puffinus opisthomelas*

Mammalia
- Artiodactyla
  - Antilocapridae - pronghorn antelopes
    - *Antilocapra americana*
  - Bovidae - cattle & bison
    - *Bison antiquus*
    - *Bison latifrons*
  - Camelidae - camels
    - *Camelops hesternus*
    - *Tanupola stevensi*
  - Cervidae - deer
    - *Odocoileus hemionus*
- Carnivora
  - Canidae - dogs
    - *Canis dirus*
  - Mustelidae - otters & skunks
    - *Enhydra lutris*
    - *Spilogale*
  - Otariidae - sea lions
    - *Arctocephalus*
    - *Eumetopias*
    - *Zalophus*
  - Phocidae - seals
    - *Mirounga angustirostris*
- Cetacea
  - Balaenopteridae - rorqual whales
    - *Balaenoptera*
  - Delphinidae - dolphins
    - *Lagenorhynchus*

Appendix A - continued

Mammalia
  Chiroptera
    Vespertilionidae - evening bats
      Antrozous pallidus
  Insectivora
    Soricidae - shrews
      Notiosorex crawfordi
      Sorex ornatus
  Lagomorpha
    Leporidae - rabbits
      Sylvilagus audubonii
      Sylvilagus bachmani
  Perissodactyla
    Equidae - horses
      Equus occidentalis
    Tapiridae - tapirs
      Tapirus californicus
      Tapirus merriami
  Proboscidea
    Elephantidae - elephants
      Mammuthus
    Mammutidae - mastodonts
      Mammut
  Rodentia
    Cricetidae - deer mice
      Microtus californicus
      Neoto fuscipes
      Peromyscus crinitus
      Peromyscus maniculatus
      Reithrodontomys megalotis
    Geomyidae - pocket gophers
      Thomomys bottae
    Heteromyidae - pocket mice
      Dipodomys agilis
      Perognathus californicus
    Sciuridae - squirrels
      Spermophilus beecheyi
  Xenarthra
    Megalonychidae - ground sloths
      Megalonyx
    Megatheriidae - giant ground sloths
      Nothrotheriops shastensis
    Mylodontidae - ground sloths
      Paramylodon

Appendix B

Publications citing LACM specimens from Quaternary terrace deposit localities between Upper Newport Bay and the University of California at Irvine

Barnes, Lawrence G. 1977. Outline of eastern North Pacific fossil cetacean assemblages. Systematic Zoology, 25(4):321-343.

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Hudson, D. M. and B. H. Brattstrom. 1977. A small herpetofauna from the late Pleistocene of Newport Beach Mesa, Orange County, California. Bulletin of the Southern California Academy of Sciences, 76(1):16-20.

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Appendix C

Composite fossil fauna based on LACM specimens from Niguel Formation localities between Upper Newport Bay and the University of California at Irvine

Chondrichthyes
- Chimaeriformes
  - Chimaeroidei - chimaeras
- Lamniformes
  - Alopiidae - thresher sharks
    - *Alopias superciliosus*
  - Lamnidae - mackerel sharks
    - *Carcharocles*
    - *Carcharodon carcharias*
- Squaliformes
  - Squalidae - dogfish sharks
    - *Squalus acanthias*

Osteichthyes
- Gadiformes
  - Merlucciidae -hakes
    - *Merluccius productus*
  - Moridae - mora cods
- Perciformes
  - Sciaenidae - croakers
    - *Seriphus*
- Scorpaeniformes
  - Cottidae - sculpins
  - Scorpaenidae - rockfishes
    - *Sebastes*

Aves
- Charadriiformes
  - Alcidae - - auks & murres
    - *Mancalla californiensis*
- Galliformes
  - Meleagridae - turkeys
    - *Meleagris*
- Procellariiformes
  - Procellariidae - shearwaters
    - *Puffinus felthami*

Mammalia
- Artiodactyla
  - Camelidae - camels
    - *Tanupolama*
- Carnivora
  - Otariidae - sea lions
- Insectivora
  - Talpidae - moles
    - *Scapanus latimanus*
- Perissodactyla
  - Equidae - horses
    - *Equus*
- Rodentia
  - Heteromyidae - pocket mice
    - *Perognathus*

Appendix D

Publications citing LACM specimens from Niguel Formation localities between Upper Newport Bay and the University of California at Irvine

Chandler, Robert M. 1990. Recent Advances in the Study of Neogene Fossil Birds. II. Fossil Birds of the San Diego Formation, Late Pliocene, Blancan, San Diego County, California. Ornithological Monographs, 44(2):73-161.

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Steadman, David W. 1980. A Review of the Osteology and Paleontology of Turkeys (Aves: Meleagridinae). Contributions in Science, Natural History Museum of Los Angeles County, 330:131-207.

Appendix E

Composite fossil fauna based on LACM specimens from Monterey Formation localities around the Chet Holifield Federal Building

- Chondrichthyes
  - Carcharhiniformes
    - Sphyrnidae - hammerhead sharks
      - *Sphyrna*
  - Chimaeriformes
    - Chimaeridae - chimaeras
      - *Hydrolagus colliei*
  - Hexanchiformes
    - Hexanchidae - cow sharks
      - *Hexanchus*
  - Lamniformes
    - Cetorhinidae - basking sharks
      - *Cetorhinus maximus*
    - Lamnidae - mackerel sharks
      - *Isurus hastalis*
  - Myliobatiformes - eagle rays
    - Myliobatidae

- Osteichthyes
  - Acipenseriformes - sturgeons
    - Acipenseridae
  - Clupeiformes
    - Clupeidae - herrings
      - *Ganolytes cameo*
  - Perciformes
    - Carangidae - jacks, amberjacks & pompanos
      - *Decapterus*
    - Embiotocidae - surfperches
      - *Amphistichus argenteus*
    - Gempylidae - snake mackerals
      - *Thyrsocles kriegeri*
    - Istiophoridae - billfishes
    - Labridae - wrasses
      - *Pimelometopon*
    - Percichthyidae - temperate basses
    - Scaridae - parrotfishes
    - Sciaenidae - croakers
      - *Cynoscion*
    - Scombridae - mackerel & tuna
    - Serranidae - groupers
      - *Epinephelus*
    - Sparidae - porgies
  - Pleuronectiformes
    - Bothidae - sanddabs
      - *Paralichthys californicus*
  - Salmoniformes
    - Salmonidae - trout & salmon
      - *Smilodonichthys rastrosus*

- Amphibia
  - Anura
    - Bufonidae - true toads

- Reptilia
  - Chelonia
    - Cheloniidae - sea turtles
      - *Chelonia*
    - Dermochelyidae - leatherback turtle
      - *Psephophorus*
  - Squamata
    - Colubridae - common colubrid snakes

- Aves
  - Charadriiformes
    - Alcidae - auks, murres & puffins
      - *Aethia*
      - *Cepphus*
      - *Praemancalla wetmorei*
      - *Uria*
  - Gaviiformes
    - Gaviidae - loons
      - *Gavia brodkorbi*
  - Pelecaniformes
    - Pseudodontornithidae - false-toothed birds
      - *Osteodontornis orri*
    - Sulidae - boobies
      - *Miosula media*
      - *Morus lompocanus*
      - *Morus magnus*
  - Procellariiformes
    - Diomedeidae - albatrosses
      - *Diomedea californica*
    - Oceanodromidae - storm petrels
      - *Oceanodroma*
    - Procellariidae - shearwaters & fulmars
      - *Puffinus barnesi*

Mammalia
- Artiodactyla
  - Antilocapridae - pronghorn antelope
- Carnivora
  - Canidae - dogs
  - Otariidae - sea lions & walruses
    - *Allodesmus kernensis*
    - Arctocephalinae
    - Desmatophocinae
    - *Imagotaria downsi*
    - Imagotariinae
    - Otariinae
    - *Pithanotaria starri*
    - *Pontolis*

Mammalia
- Cetacea
  - Albireonidae - extinct dolphins
  - Balaenopteridae - rorqual whales
  - Cetotheriidae - extinct baleen whales
    - *Mixocetus*
    - *Nannocetus*
  - Delphinidae - dolphins
  - Kentriodontidae - extinct primitive dolphins
    - *Pithanodelphis nasalis*
  - Monodontidae - narwhals & belugas
  - Phocoenidae - porpoises
  - Physeteridae - sperm whales
    - *Scaldicetus*
  - Rhabdosteidae - extinct long-snouted dolphins
  - Ziphiidae - beaked whales
- Desmostylia
  - Desmostylidae - extinct qradupedal marine mammals
    - *Desmostylus*
- Sirenia
  - Dugongidae - sea cows
    - *Dusisiren jordani*

Appendix F

Publications citing LACM specimens from Monterey Formation localities around the Chet Holifield Federal Building

Barnes, Lawrence G. 1977. Outline of Eastern North Pacific Fossil Cetacean Assemblages. Systematic Zoology, 25(4):321-343.

Barnes, Lawrence G. 1985. The Late Miocene Dolphin *Pithanodelphis* Abel, 1905 (Cetacea: Kentriodontidae) from California. Contributions in Science, Natural History Museum of Los Angeles County, 367:1-27.

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Kobayshi, Shoji, Hideo Horikawa, and Shigeo Miyazaki. 1995. A New Species of Sirenia (Mammalia: Hydrodamalinae) from the Shiotsubo Formation in Takasato, Aizu, Fukushima Prefecture, Japan. Journal of Vertebrate Paleontology, 15(4):815-829.

Mitchell, Edward D. 1961. A New Walrus from the Imperial Pliocene of Southern California; with Notes on Odobenid and Otariid Humeri. Contributions in Science, Natural History Museum of Los Angeles County, 44:1-28.

Mitchell, Edward D. 1966. The Miocene Pinniped *Allodesmus*. University of California Publications in Geological Sciences, 61:1-105.

Muizon, Christian de. 1989. Les Vertébrés Fossiles de la Formation Pisco (Pérou). Troisième partie: Les Odontocètes (Cetacea, Mammalia) du Miocène. Institut Française d'Études Andines Mémoire, 42:1-244.

Appendix G

Composite fossil fauna based on LACM specimens from Capistrano Formation localities north of the Sulphur Creek Reservoir

- Chondrichthyes
  - Carcharhiniformes
    - Carcharhinidae - requiem sharks
      - *Carcharhinus priscus*
      - *Galeocerdo aduncus*
    - Sphyrnidae - hammerhead shakrs
      - *Sphyrna lewini*
      - *Sphyrna zygaena*
  - Chimaeriformes
    - Chimaeridae - chimaeras
      - *Chimaera*
  - Hexanchiformes
    - Hexanchidae - cow sharks
      - *Hexanchus*
  - Lamniformes
    - Cetorhinidae - basking sharks
      - *Cetorhinus*
    - Lamnidae - mackerel sharks
      - *Carcharodon carcharias*
      - *Carcharodon sulcidens*
      - *Isurus hastalis*
      - *Isurus oxyrinchus*
  - Myliobatiformes
    - Myliobatidae - eagle rays
      - *Myliobatis*
  - Squatiniformes
    - Squatinidae - angel sharks
      - *Squatina*

- Osteichthyes
  - Acipenseriformes
    - Acipenseridae - sturgeons
      - *Acipenser*
  - Ophidiiformes
    - Ophidiidae - cusk eels
  - Perciformes
    - Anarhichadidae - wolf eels
      - *Anarrhichthys*
    - Carangidae - jacks
      - *Decapterus*
    - Gempylidae - snake mackerels
      - *Thyrsocles kriegeri*
    - Labridae - wrasses
      - *Pimelometopon pulchrum*
      - *Semicossyphus*
    - Oplegnathidae - knifejaws
  - Pleuronectiformes
    - Bothidae - sanddabs
      - *Paralichthys*
  - Salmoniformes
    - Salmonidae - trout & salmon
      - *Smilodonichthyes rastrosus*

- Reptilia
  - Testudinata
    - Dermochelyidae - leatherback turtles
      - *Psephophorus*

- Aves
  - Anseriformes
    - Anatidae - ducks

- Mammalia
  - Carnivora
    - Otariidae - sea lions
      - *Arctocephalus*
      - Odobeninae
  - Cetacea
    - Balaenopteridae - rorqual whales
    - Delphinidae - dolphins
    - Phocoenidae - porpoises
      - *Piscolithax*
    - Physeteridae - sperm whales
      - *Scaldicetus*
  - Sirenia
    - Dugongidae - dugongs
      - *Hydrodamalis cuestae*

APPENDIX D

RESUMES

BROOKS R. SMITH

PALEONTOLOGIST/GEOLOGIST

EXPERTISE

Paleontological and Archaeological Resource Monitoring
Archaeological Excavation
Fossil Collection, Salvage, Identification and Curation
Geologic Data Collection and Interpretation
GPS Data Collection and Analysis
Paleontological Assessment Reports
Final Archaeological and Paleontological Mitigation Monitoring Reports

EDUCATION

University of California, Santa Cruz, B.S., Earth Science (Geology), 1989.

California State University, Fullerton, Archaeological field methods course on San Nicolas Island, June–July 1993.

CERTIFICATIONS

40-Hour Hazardous Materials Handling and Response, current through June 2008
County of Orange, Certified Paleontologist

PROFESSIONAL EXPERIENCE

Archaeological and Paleontological Surveyor, Monitor, Excavator and Report Preparer; and Paleontological Field Director, LSA Associates, Inc., Irvine, California, July 1992–present.

Geologist, Mission Geoscience, Newport Beach, California, November 1993–February 1994.

Paleontologist, John Minch and Associates, San Juan Capistrano, California, February–June 1992.

Geologist, Soil and Testing Engineers, Inc., Placentia, California, September 1989–February 1992.

PRINCIPAL PROFESSIONAL RESPONSIBILITIES

Intensive field surveys for paleontological and archaeological remains prior to grading activities; monitoring for and collecting cultural and scientific resources during grading activities; documentation and testing of archaeological sites; salvage of large fossil remains with the use of plaster casts; large-scale wet and dry screening of sediments for fossils; identification and curation of fossils after they have been collected; collection and analysis of data from hand held Global Positioning Satellite (GPS) units; collection of geologic data; and archaeological and paleontological report preparation.

RECENT REPORTS

Results of Paleontological Resources Mitigation Monitoring for a 23-Acre Inland Empire Utilities Agency Parcel, City of Chino Hills, San Bernardino County, California. Prepared for McKenna Construction. LSA project number MKG0601. July 2007.

Paleontological Resources Assessment Widening of El Camino Real North of Cougar Drive in the City of Carlsbad, San Diego County, California. Prepared for the City of Carlsbad – Design Division. LSA project number HCR0701. June 2007.

Results of Paleontological Resources Mitigation Monitoring Villa Del Lago, City of Newport Beach, Orange County, California. (With Meredith Staley as lead author). Prepared for One Pelican Hill North, LP. LSA project number MRE430. April 2007.

Cultural Resources Mitigation Monitoring Report, Villa Del Lago, City of Newport Beach, Orange County, California. (With Antonina Delu, MA, RPA as lead author). Prepared for One Pelican Hill North, LP. LSA project number MRE430. April 2007.

Paleontological Identification and Evaluation Report – S-91 Eastbound Lane Addition Project Between SR-241 and SR-71. Orange County California District 12-ORA-91 PM15.9/19.9 and Riverside County, California, District 8-RIV-91 PM 0.0/2.9. Prepared for the Orange County Transportation Authority, under contract to Kimley Horn and Associates. LSA project number KHA0601. May 2007.

Archaeological Investigations at Saint Margaret's Episcopal School and Church, 31641 La Novia Avenue, San Juan Capistrano, Orange County, California. Prepared for Saint Margaret's Episcopal School and Church. (With Antonina Delu, MA, RPA primary author). LSA project number SMU0601. February 2007.

Results of Paleontological Assessment for the 4000 Metropolitan Project, City and County of Orange, California. Letter report to West Millennium Homes. LSA project number WHM0602. January 2007.

Paleontological Resource Assessment of 33.54 Acres In the City of Perris, Riverside County, California. Prepared for DMC Design Group, Inc. LSA project number DMP0601. January 2007.

Paleontological Resources Assessment Chula Vista Energy Efficiency Upgrade Project In the City of Chula Vista San Diego County, California. Prepared MMC Energy, Inc. LSA project number MME0601. December 2006.

Paleontological Resources Mitigation Monitoring Report – Saint Mark Presbyterian Church Project, City of Newport Beach, Orange County, California. Prepared for Barnard Ventures, LLC. LSA project number BAV530. December 2006.

Paleontological Resource Assessment Canyon Ridge Residential Development – Upper Lots Assessor's Parcel Number 643-090-032 City of La Quinta, Riverside County, California. Prepared for Laing Luxury Homes. LSA project number LAH0601. November 2006.

Paleontological Resource Assessment – Del Mar Fairgrounds Master Plan Project, in the Cities of Del Mar and San Diego, San Diego County, California. Prepared for the 22nd District Agricultural Association. LSA project number DLM0601. November 2006.

Paleontological Resource Assessment Report – Integrated Waste Management District Frank R. Bowerman Landfill Master Development Plan, Orange County, California. (With Steve Conkling).

Report prepared for the Integrated Waste Management District. LSA project number PND0601. September 2006.

Archaeological l Mitigation Monitoring Report – Orange County Regional Sheriff Training Facility, City of Tustin, Orange County California. (With Deborah K. B. McLean). Prepared for Rancho Santiago Community College District. LSA project number RSC531. September 2006.

Paleontological Mitigation Monitoring Report – Orange County Regional Sheriff Training Facility, City of Tustin, Orange County California. (With Steve W. Conkling). Prepared for Rancho Santiago Community College District. LSA project number RSC531. September 2006.

Cultural Resources Survey for the Frank R. Bowerman Landfill Master Development Plan, Orange County, California. (With Ivan H. Strudwick, Dustin R. Kay, and Antonia M. Delu). Prepared for the County of Orange Integrated Waste Management Department. LSA project number PND0601. August 2006.

Archaeological Survey Report for the Proposed South Orange County Transportation Infrastructure Improvements Project in Orange and San Diego Counties (with Phil Fulton, Ivan Strudwick, Terri Fulton, and Roderic McLean). Report prepared for the Federal Highway Administration, California Division. LSA project number PND130. May 2006. Revised October 2006

Pedestrian Survey, San Mateo and Cristianitos Valleys, Marine Corps Base Camp Pendleton, California (with Phil Fulton, Roderic McLean, and Ivan Strudwick). Report prepared for the Marine Corps Base Camp Pendleton. LSA project number PND130. May 2006. Revised October 2006

Results of Archaeological Resource Mitigation Monitoring for Crystal Cove Planning Areas 4A and 4B, Phase II, Upper Merchants Area D Rough Grading and Storm Drain Improvements, Crystal Cove Area, Orange County, California (with Deborah K. B. McLean). Report prepared for Irvine Community Development Company. LSA project number ICD431. April 2006.

Results of Paleontological Resource Mitigation Monitoring for Crystal Cove Planning Areas 4A and 4B, Phase II, Upper Merchants Area D Rough Grading and Storm Drain Improvements, Crystal Cove Area, Orange County, California (with Steven W. Conkling). Report prepared for Irvine Community Development Company. LSA project number ICD431. April 2006.

Archaeological Monitoring Report for the Orchard at Saddleback, Phase II, City of Lake Forest, Orange County, California. Report prepared for Wetrust America, Inc. (with Deborah K. B. McLean). LSA project number MPX531. April 2006.

Paleontological Monitoring Report for the Orchard at Saddleback, Phase II, City of Lake Forest, Orange County, California. Report prepared for Wetrust America, Inc. (with Steven W. Conkling). LSA project number MPX531. April 2006.

A Glimpse of the Past on Pimu: Cultural Resource Survey, Santa Catalina Island, Los Angeles County, California (with Ivan H. Strudwick, Roderic McLean, Jay Michalsky, and Joseph E. Baumann). Report prepared for Southern California Edison. LSA project number SCE330C. March 2006.

Paleontological Resource Assessment for the Lambert Ranch, City of Irvine, Northern Sphere, Orange County, California. Report prepared for Sapetto Group, Inc. LSA project number LAE430. January 2006.

Results of Archaeological Resource Mitigation Monitoring for Crystal Cove Planning Areas 4A and 4B, Phase II, Lower Customs Areas A and B and Upper Customs Area C including Disposal Site

Grading, Sewer and Storm Drain Improvements, Crystal Cove Area, Orange County, California (with Deborah K. B. McLean). Report prepared for Irvine Community Development Company. LSA project number ICD351. January 2006.

Results of Paleontological Resource Mitigation Monitoring for Crystal Cove Planning Areas 4A and 4B, Phase II, Lower Customs Areas A and B and Upper Customs Area C, including Disposal Site Grading, Sewer and Storm Drain Improvements, Crystal Cove Area, Orange County, California (with Steven W. Conkling). Report prepared for Irvine Community Development Company. LSA project number ICD351. January 2006.

Archaeological Monitoring Report, Chino Hills Corporate Park, City of Chino Hills, San Bernardino County, California (with Shannon Carmack and Deborah K. B. McLean). Report prepared for Chino Hills Corporate Park, L. P. LSA project number RIL430. January 2006.

Paleontological Monitoring Report, Chino Hills Corporate Park, City of Chino Hills, San Bernardino County, California (with Shannon Carmack and Steven W. Conkling). Report prepared for Chino Hills Corporate Park, L. P. LSA project number RIL430. January 2006.

Paleontological Resource Assessment, The Peninsular Village Overlay Zone, City of Rolling Hills Estates, Los Angeles County, California (with Shannon Carmack). Report prepared for the Planning Department, City of Rolling Hills Estates. LSA project number RHT530. January 2006.

Archaeological Mitigation Monitoring Report, New Drainage Pond and Slide Repair, Joplin Youth Center, Trabuco Canyon, Orange County, California (with Deborah K. B. McLean). Report prepared for DMJMH+N. LSA project number DMJ431. December 2005.

Paleontological Mitigation Monitoring Report, New Drainage Pond and Slide Repair, Joplin Youth Center, Trabuco Canyon, Orange County, California (with Steven W. Conkling). Report prepared for DMJMH+N. LSA project number DMJ431. December 2005.

Results of Archaeological Mitigation Monitoring for Newport Coast, Phase IV-4 Residential Planning Areas 2C, 5 and 6, Newport Coast, Orange County, California. Report prepared for Irvine Community Development Company. LSA project number ICD238. November 2005.

Results of Paleontological Mitigation Monitoring for Newport Coast, Phase IV-4 Residential Planning Areas 2C, 5 and 6, Newport Coast, Orange County, California. Report prepared for Irvine Community Development Company. LSA project number ICD238. November 2005.

Paleontological Monitoring Report for the Orchard at Saddleback, City of Lake Forest, Orange County, California. Report prepared for W.A.L.F., LLC. LSA project number MPX530. June 2005.

Archaeological Mitigation Monitoring Report January 2003–June 2004, Integrated Waste Management District, Frank R. Bowerman Landfill, Orange County, California. Report prepared for Integrated Waste Management District. LSA project number IWM030. January 2005.

Paleontological Mitigation Monitoring Report January 2003–June 2004, Integrated Waste Management District, Frank R. Bowerman Landfill, Orange County, California. Report prepared for Integrated Waste Management District. LSA project number IWM030. January 2005.

Archaeological Mitigation Monitoring Summary Report January 2001–June 2004, Integrated Waste Management District, Frank R. Bowerman Landfill, Orange County, California. Report prepared for Integrated Waste Management District. LSA project number IWM030. January 2005.

Paleontological Mitigation Monitoring Report January 2001–June 2004, Integrated Waste Management District, Frank R. Bowerman Landfill, Orange County, California. Report prepared for Integrated Waste Management District. LSA project number IWM030. January 2005.

Paleontological Resource Assessment for the Melrose Triangle Project, City of West Hollwood, Los Angeles County, California. Report prepared for the City of West Hollywood. LSA project number CWH430. January 2005.

Paleontological Resources Assessment for the Stockton Waterfront West Arena Project, City of Stockton, San Joaquin County, California. Letter prepared for Foothill Resources, Ltd. LSA project number FRS430. June 2004.

Paleontological Mitigation Monitoring for the West Bluffs Project, TT 51122, City and County of Los Angeles. Report prepared for Catellus Residential Unit. LSA project number CRH230. May 2004.

Results of Archaeological Resource Mitigation Monitoring, Fire Station 55, Irvine, California. Report prepared for Irvine Community Development Company. LSA project number ICD352. March 2004.

Results of Paleontological Resource Mitigation Monitoring, Fire Station 55, Irvine, California. Report prepared for Irvine Community Development Company. LSA project number ICD352. March 2004.

Cultural Resource Assessment for the Olinda Alpha Landfill Expansion, Orange County, California (with Deborah K. B. and Roderic N. Mclean). Report prepared for the County of Orange Resources and Development Management Department. LSA project number PND830. February 2004.

Paleontological Resource Assessment for the Olinda Alpha Landfill Expansion, Orange County, California (with Steven W. Conkling). Report prepared for the County of Orange Resources and Development Management Department LSA project number PND830. February 2004.

Paleontological Assessment of 15.45 Acres, Sunset Aquatic Park Project, Orange County, California. Report prepared for County of Orange Public Facilities and Resource Division. LSA project number GRK330. January 2004.

Results of Archaeological Mitigation Monitoring for Wishbone Ridge Emergency Access Road, Crystal Cove Area, Orange County, California (with Kevin Buffington). Report prepared for Irvine Community Development Company LSA project number ICD338. December 2003.

Results of Archaeological Mitigation Monitoring for Beachtown II, Crystal Cove Area, Orange County, California (with Kevin Buffington). Report prepared for Irvine Community Development Company. LSA project number ICD140. December 2003.

Results of Paleontological Mitigation Monitoring for Beachtown II, Crystal Cove Area, Orange County, California. Report prepared for Irvine Community Development Company. LSA project number ICD140. December 2003.

Results of Archaeological Resource Mitigation Monitoring for PA 4A and 4B, Phase I, Crystal Cove Area, Orange County, California (with William Sawyer and Kevin Buffington). Report prepared for Irvine Community Development Company. LSA project number ICD241. December 2003.

Results of Paleontological Resource Mitigation Monitoring for PA 4A and 4B, Phase I, Crystal Cove Area, Orange County, California. Report prepared for Irvine Community Development Company. LSA project number ICD241. December 2003.

Cultural Resource Assessment, Far West Housing, LLC, Nastranero Project, Riverside County. Report prepared for Far West Housing, LLC. LSA project number FWH330. August 2003.

Paleontological Resource Assessment, Far West Housing, LLC, Nastranero Project, Riverside County. Report prepared for Far West Housing, LLC. LSA project number FWH330. August 2003.

Results of Archaeological Monitoring Robert B. Diemer Filtration Project. Carbon Canyon and Telegraph Creeks, Chino Hills State Park, Orange County, California. Report prepared for the Metropolitan Water District of Southern California (with Shannon Younger, William Sawyer and Kevin Buffington). LSA project number MWD130. July 2003.

Results of Paleontological Monitoring Robert B. Diemer Filtration Project. Carbon Canyon and Telegraph Creeks, Chino Hills State Park, Orange County, California. Report prepared for the Metropolitan Water District of Southern California (with Shannon Younger). LSA project number MWD130. July 2003.

Results of Archaeological and Paleontological Monitoring Upper Bommer Trail Emergency Access Road Improvements and Habitat Restoration Area, Bommer Canyon, City of Irvine, Orange County, California. Report prepared for The Irvine Company. LSA project number TIC245. June 2003.

Results of Paleontological Monitoring, The Bluffs Retail Center, Orange County, California. Report prepared for The Irvine Company. LSA project number TIC230. March 2003.

Results of Archaeological Construction Monitoring, Planning Area 27, Needle Grass Creek Conservation Area, Irvine, California (with Shannon Younger). Report prepared for Irvine Community Development Company. LSA project number ICD146. March 2003.

Results of Paleontological Monitoring, State Route 73 Median Improvements, Stations 74+00 to 82+00, City of Costa Mesa, Orange County, California. Report prepared for Coffman Specialties, Inc. LSA project number INC230. March 2003.

Results of Archaeological and Paleontological Monitoring Turtle Ridge (Planning Area 27) Habitat Mitigation Project. Bommer Canyon, City of Irvine, Orange County, California. Report prepared for Irvine Community Development Company (with Shannon Younger). March 2003.

PROFESSIONAL MEMBERSHIPS/AFFILIATIONS

San Diego Association of Geologists
South Coast Geologic Society
UCSC Alumni Association
Society of Vertebrate Paleontology

MEREDITH A. STALEY

PALEONTOLOGIST
LABORATORY DIRECTOR

EXPERTISE

Taphonomic and paleoecological analysis
Fossil preparation
Geologic data collection and analysis
Access Database design and management
Archaeological Faunal Analysis
Archival Curation Procedures

EDUCATION

B.S. in Geology, California Polytechnic University, Pomona, 2003.

In Progress: M.Sc. in Geological Sciences, California State University, Fullerton, expected graduation in December 2009.

Student-in-Residence, Los Angeles County Natural History Museum, Los Angeles, California, 2008-present.

PROFESSIONAL EXPERIENCE

Director of Archaeology and Paleontology Laboratory, LSA Associates, Inc. Irvine, California, 2005 to present.

Paleontologist Field Crew, LSA Associates, Inc., Irvine, California, 2003 to present.

Vertebrate Paleontology Preparator, Los Angeles County Natural History Museum, Los Angeles, California, 2007 to present.

Laboratory Volunteer, George C. Page Museum of La Brea Discoveries, Los Angeles, California, 2007

Student Intern, LSA Associates, Inc., Irvine, California, 2001 to 2003.

Student Intern, Association of American State Geologists, 2002 to 2003.

Student Intern, Geosciences Support Services, 2002.

Bernard O. Lane Paleontology Laboratory Student Curator, California State Polytechnic University, Pomona, 2001 to 2003

Student Aid, California State Polytechnic University, Pomona, 1999 to 2003

PRINCIPAL PROFESSIONAL RESPONSIBILITIES

As the Laboratory Director at LSA Associates, Inc., Ms. Staley's duties include the development and management of lab databases, management of fossils and artifacts into and out of the lab, curational storage procedures, management of lab equipment, and supervision of student interns. Additional laboratory duties include paleontological identification and analysis, fossil preparation, rock identification and geologic analysis. Ms. Staley is also responsible for research and development of monitoring reports.

As a field technician, she is responsible for resource recognition, field identification, documentation, and salvage.

SPECIFIC PROJECT EXPERIENCE

Park Place
Irvine, California
Contributed to the micro and macro fossil identification and cataloging of paleontological resources recovered during the monitoring of this apartment complex. Also conducted independent research on the taphonomy of *Capromeryx minor* and presented these results at the Western Association of Vertebrate Paleontologists (WAVP) Conference and at the Desert Symposium in 2003.

Catellus Residential
Los Angeles, California
Paleontological monitor for the grading on West Bluffs in the Palos Verdes Sands. Collection of marine shell assemblage and marine mammal skeletal fragments.

Laguna Canyon Road
Orange County, California
Paleontological and archaeological monitor for realignment of SR-133. Collection of marine mammal skeletal fragments, wet screening of mass samples for microfossils, and laboratory preparation of vertebrate fossil material. Geologic mapping and correlation of fossiliferous rock units. Rock type identification of archeological artifacts. Created Access database and photograph library for paleontological collection of nearly 3,000 specimens. Authored sections of final mitigation report.

FRB Landfill
Irvine, California
Paleontological and archaeological monitor in Puente, Sespe, and Vaqueros formations. Discovery and salvage of marine mammal and fish fossils.

El Toro Materials
El Toro, California
Paleontological monitor and salvage in Oso Formation, laboratory preparation of vertebrate fossil material, identification and catalog.

Southern California Edison
Wrightwood, California
Archaeological survey.

Sun-Cal
Beaumont, California
Paleontological and archaeological monitor in alluvium and San Timoteo Formation, mass sample collection of San Timoteo Formation for small mammal fossils, archeological site excavation, evaluation and data recovery, historical data collection and analysis of Haskell Ranch Complex, and historical archeology excavation of Noble Adobe(s). Also created database for prehistoric and historic artifacts recovered from site.

Anaheim Corners
Anaheim, California
Archaeological monitor in alluvium and Santa Ana River sands.

Fossils in Your Backyard
Orange County Schools
Speaker at assemblies, in classrooms, and for events on paleontology in Orange County schools.

Shady Canyon
Irvine, California
Paleontological monitor in Bommer member of Topanga Formation and Vaqueros Formation for various home developers in Shady Canyon. Irvine, California. Created final mitigation letters for various developers.

Viejo Substation and Transmission Line
Tustin, California
Report development, catalog.

PA-1
Irvine, California
Paleontological and archaeological monitor in Quaternary alluvium, Vaqueros, and Santiago Formations, catalog.

PA-9C1
Irvine, California
Paleontological and archaeological monitor in Quaternary alluvium. Report development.

Villa del Lago
Newport Beach, California
Paleontological and archaeological monitor in Quaternary alluvium. Wrote final mitigation report.

Muddy Canyon
Newport Beach, California
Created database for lithic artifacts already catalogued from site, compiled data, and report development of lithics chapter. Identification and catalog of faunal material.

SCE Projects
Various Locations
Created master and individual databases for documentation of surveys for SCE pole circuits.

Pacific Medical
Irvine, California
Wrote final letter for paleontological monitoring, and letter for archaeological monitoring.

Pacific Club
Irvine, California
Paleontological and archaeological monitor in Quaternary alluvium.

Sheriff Training Facility
El Toro Marine Base, Tustin, California
Paleontological and archaeological monitor in Quaternary alluvium.

St. Mark's Presbyterian Church
Newport Beach, California
Paleontological and archaeological monitor in Quaternary alluvium and Monterey Formation, catalog.

McKenna Construction
Chino, California
Archaeological monitor in Quaternary alluvium.

Foothill Transportation Corridor, Geotechnical
Mission Viejo, California
Paleontological and archaeological monitor in Quaternary Alluvium, Capistrano, Sespe/Vaqueros, and Santiago Formation.

Marshburn Basin
Irvine, California
Paleontological and archaeological monitor in Quaternary alluvium.

IRWD 16-inch Domestic Water Pipeline
Irvine, California
Paleontological and archaeological monitor in Quaternary alluvium and Sespe/Vaqueros Formation; report development.

Stonegate
Irvine, California
Paleontological and archaeological monitor in Quaternary alluvium and Sespe/Vaqueros Formation.

I-5/HOV Truck Lanes
Los Angeles, California
Paleontological Technical Report.

Eagle Crest
Bakersfield, California
Paleontological and Archaeological monitor in recent Alluvium, Pleistocene Alluvium, and Round Mountain Silt. Discovery and salvage of several fossil remains, including Pleistocene vertebrates, Miocene marine mammals, invertebrates, and fish.

3303 Huntington Drive Monitoring
Pasadena, California
Faunal identification

The Village at Irvine Spectrum Center
Irvine, California
Catalog, wrote final mitigation report.

PA-18
Irvine, California
Identification of Vertebrate and Invertebrate fossil remains, lab preparation of vertebrate fossils, catalog.

Mid County Parkway
Hemet, California
Faunal Analysis, Lithic material identification, Database development.

PROFESSIONAL AFFILIATIONS

Geological Society of America (GSA)
Society for Sedimentary Geology (SEPM)
Society of Vertebrate Paleontology (SVP)

REPORTS AND PUBLICATIONS

Results of Paleontological Resource Mitigation Monitoring for Laguna Canyon Road (State Route 133) Widening and Realignment Project (with Brooks Smith, Lawrence Barnes, Steven Conkling, and Robert Reynolds) Report prepared for the California Department of Transportation. LSA Project Numbers SEM330 and BOT0701E. June 2008.

Unearthing the Unexpected: Early Miocene Toothed Cetaceans from Orange County, California. Poster prepared for South Coast Geological Society meeting, 2007.

Paleontological Mitigation Monitoring Report for the Village at Irvine Spectrum Center, City of Irvine, Orange County, California. (with Brooks Smith and Steven Conkling) Report prepared for Irvine Apartment Communities. LSA Project Number IAC430. August 2007.

Results of Paleontological Resource Mitigation Monitoring, Villa del Lago, City of Newport Beach, California. (with Brooks Smith) Report prepared for One Pelican Hill North, LP. LSA Project Number MRE430. April 2007.

Paleontological Resources Assessment of the Interstate 5 Project Area Between State Route 14 Interchange to Parker Road, Los Angeles County, California. (with Brooks Smith and Steven Conkling) Report prepared for Signal Landmark. LSA Project Number SIB0601. February 2007.

"The Diverse Pleistocene Assemblage of Park Place, Irvine, California." *Western Association of Vertebrate Paleontologists, Abstracts.* February 2007.

Paleontological Resource Mitigation Monitoring Results for the Viejo Substation and Transmission Line Project, Orange County, California: LSA Project Number SCE442. Report Prepared for Southern California Edison. May 2006.

"Preliminary Description of *Capromeryx minor* from Park Place, Irvine, California." *Western Association of Vertebrate Paleontologists, Program and Abstracts.* 2003.

"Evidence for Predation of *Capromeryx minor* in Pleistocene deposits of Park Place, Irvine, California." *Land of Lost Lakes: The 2003 Desert Symposium Field Trip Guide and Abstracts.* 2003.

Taphonomic Analysis of an Abundance of Capromeryx minor remains, from the Pleistocene Deposits of Park Place, Irvine, California. A Senior Thesis Submitted in partial fulfillment of the requirements for the degree of Bachelor's of Science in Geology, Department of Geological Sciences, California State Polytechnic University, Pomona.